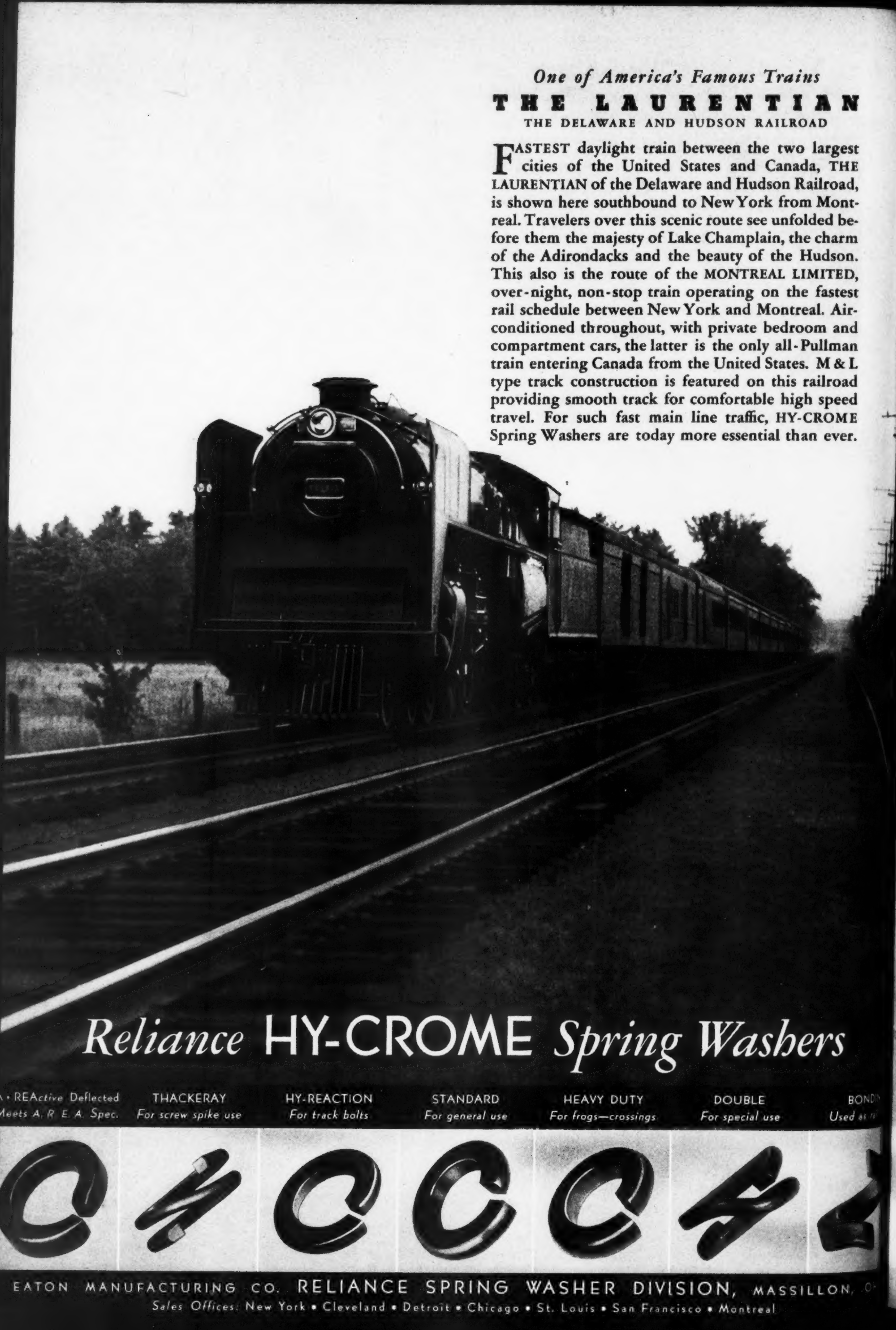
Railway Engineering and Maintenance


One of America's Famous Trains
THE LAURENTIAN
THE DELAWARE AND HUDSON RAILROAD
FASTEST daylight train between the two largest cities of the United States and Canada, THE LAURENTIAN of the Delaware and Hudson Railroad, is shown here southbound to New York from Montreal. Travelers over this scenic route see unfolded before them the majesty of Lake Champlain, the charm of the Adirondacks and the beauty of the Hudson. This also is the route of the MONTREAL LIMITED, over-night, non-stop train operating on the fastest rail schedule between New York and Montreal. Air-conditioned throughout, with private bedroom and compartment cars, the latter is the only all-Pullman train entering Canada from the United States. M & L type track construction is featured on this railroad providing smooth track for comfortable high speed travel. For such fast main line traffic, HY-CROME Spring Washers are today more essential than ever.
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EATON MANUFACTURING CO. RELIANCE SPRING WASHER DIVISION, MASSILLON,
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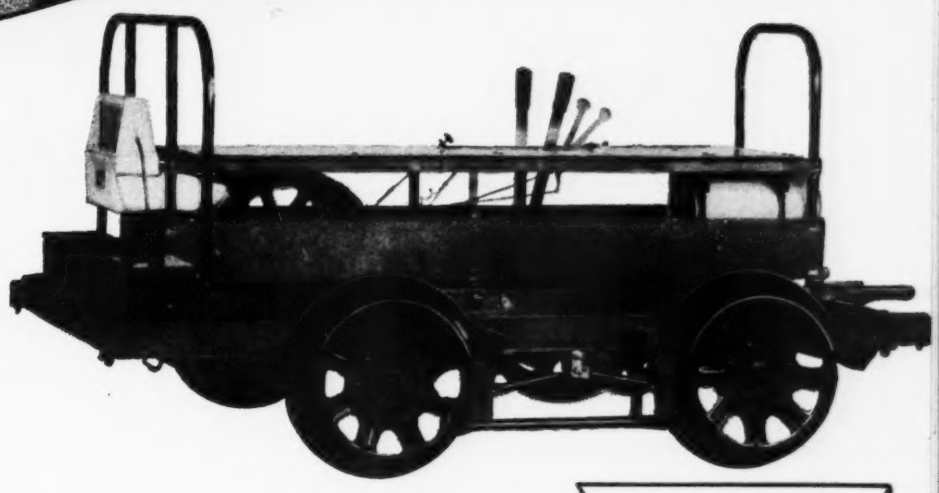
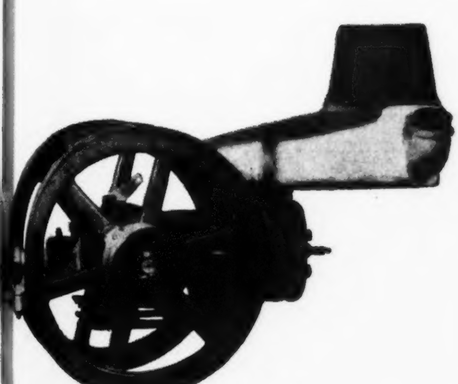
PNEUMATIC
TIE TAMPING
For SMOOTH and SAFER
TRACK at LOWEST COST
IR

FOR LOW COST



1 to 6 Man Light Section Car

M14 SERIES E



Many years of universal service on railroads has proved the efficiency and dependability of this Fairmont Model O Engine which has been consistently improved and is now applied to six Fairmont cars.

DESIGN, sturdy construction, and surplus power—these three elements are built into this Fairmont M14 for the delivery of a wide range of service at record low cost. It is Fairmont's latest Light Section Car with a rear pick-up of only 105 lbs. so that one man handles it easily . . . yet it carries 6 to 8 men and also fits into jobs that call for trailer or push car work. It is powered with a surplus for the heavier duties by the famous Fairmont Model O (5-8 H.P.) Engine that railroad men know for its dependability and economy—the same engine that furnishes power for five other Fairmont cars. This car has all the operating and economy features of the M14 in aluminum, the chief difference being that the frame is of reinforced steel construction, to combine *low initial cost* with that *low over-all cost* which is the characteristic of all Fairmont Cars.

FAIRMONT RAILWAY MOTORS, Inc., Fairmont, Minn.

Inspection Motor Cars . . . Section Motor Cars . . . B & B and Extra Gang Cars . . . Gas-Electric Ditchers . . . Shapers . . . Ballast Cleaners . . . Ballast Drainage Cars . . . Mowers . . . Weed Burners . . . Extinguisher Cars . . . Power Cars: Air, Electric, Paint Spray, Tie Tamping . . . Rail Coaches . . . Motor Car Engines . . . Push Cars and Trailers . . . Roller Axle Bearings . . . Wheels and Axles

Performance ON THE JOB COUNTS

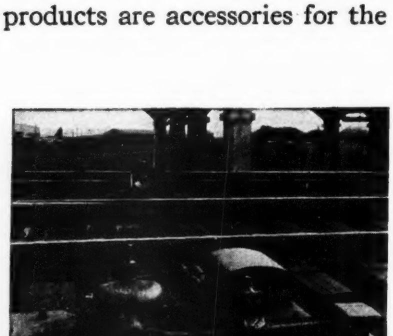
Fairmont

These accessories help to make Streamline track for

PASSENGER trains soaring into the stratosphere of speeds on rails, and long, heavy freight trains invading the speed domain until recently reserved to passenger service, bear down heavily on track and track equipment. At the same time, even higher standards of track maintenance are essential to keep the ride smooth and safe as the 100-mile-per-hour mark is approached.

The items of Bethlehem Track Equipment described here all have features fitting them for the exacting demands of these days. Where rugged, unyielding strength is needed they have it in full measure. Where resilience is essential, to permit absorbing shocks, it is built into them. They are made adjustable wherever such construction will help to keep track tuned up to the requisite standards. In all respects these products are accessories for the track of these days.

The Bethlehem Positive Signal Stand



The Bethlehem Positive Signal Stand provides the opportunity to raise safety standards to a new high level. It gives a positive continuous distant-signal report on conditions right at points—warning of any dangerous conditions, even when of such a nature that the target indicates clear.

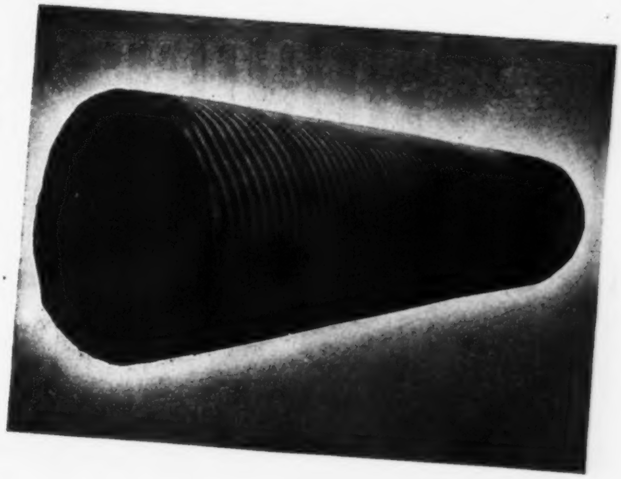
This safety device, besides operating a distant signal, functions as a switch stand and throws a derail on a turnout. It includes a two-rod facing-point lock and detector bar protection for the switch-points. The assembly is conveniently compact, easy to install, simple to adjust, and readily accessible.

The New Century Switch Stand

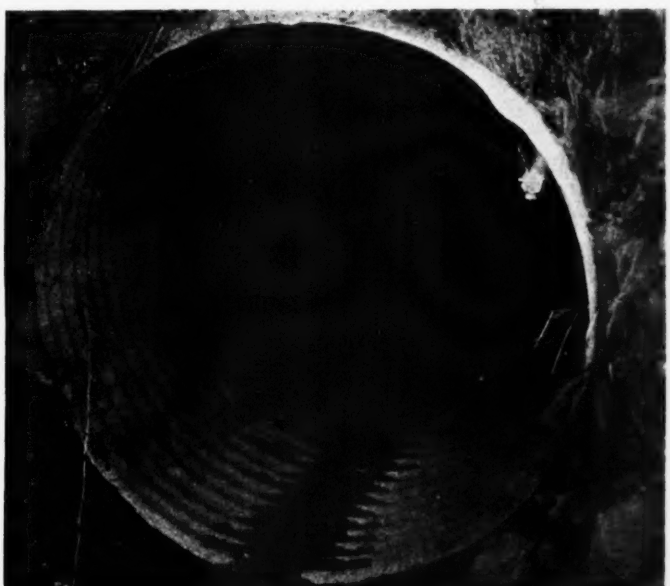
The New Century Switch Stand is built to a design proved fundamentally sound through service on leading railways over a period of more than forty years. It has been continually strengthened and improved as the demands upon switch stands have become more severe. Parts made of heat-treated alloy steel provide rugged strength well ahead of present-day requirements.

Bethlehem makes other switch stands equally well suited to their fields of service. Among them is Model 1222, an ideal stand to use in yards where sorting and train-make-up requirements call for a stand that can be operated quickly and easily.

Here's the first corrugated pipe—made and installed in 1896, near Crawfordsville, Ind.—removed for exhibition, after 28 years in the ground.



3 *Events* THAT MADE DRAINAGE HISTORY



IN 1896: Many of the objections to existing types of drainage structures were eliminated by the invention of corrugated metal pipe. Its long, light-weight sections brought about immediate savings in hauling and installation costs. Moreover, due to its flexibility and sturdy joints, corrugated pipe soon proved its ability to stand up where other types couldn't take it. And it has continued to prove its superior strength ***for 40 years.***

IN 1906: The development of rust-resisting ARMCO Ingot Iron created a high standard of durability for corrugated pipe. In fact, many of these pure iron drains are sound and strong today—after ***30 years of service.***

IN 1926: ARMCO engineers raised the standard of corrugated pipe still higher, by putting a thick bituminous pavement in the bottom, where the wear comes. This improved product—known as ARMCO Paved Invert Pipe—gives you the 40-year strength of corrugated metal; the 30-year durability record of pure iron; plus an ***extra 10 years*** of service, already established by the protected bottom. No wonder more and more railway engineers are turning to ARMCO Paved Invert Pipe, for every drainage purpose. It costs less because it lasts longer. Make us prove it.

Above: **After 30 years of service, this ARMCO pure iron culvert is still functioning 100%.**

Below: **ARMCO Paved Invert Pipe—paved where the wear comes, with a special bituminous material.**

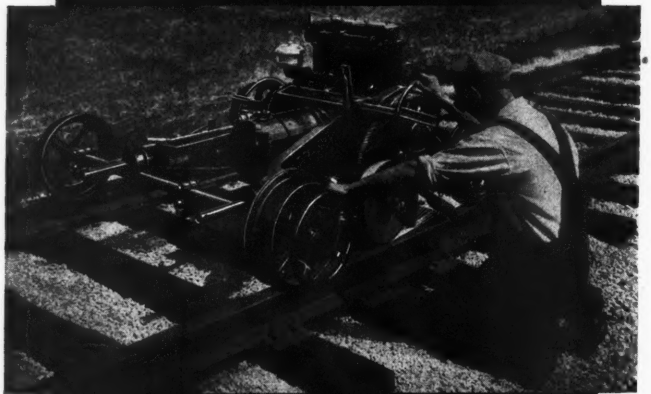
ARMCO

INGOT IRON RAILWAY PRODUCTS CO. • • Middletown, Ohio • • Berkeley, Calif.

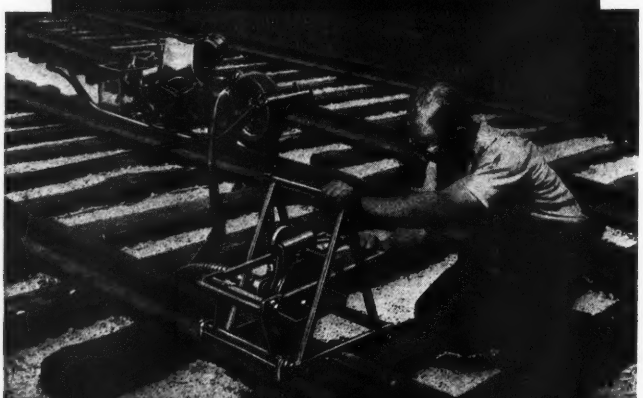
3 NORDBERG GRINDERS

A grinder for every track grinding job

A Cup Wheel Precision Grinder for providing a smoother surface on welded rail, for removing mill tolerance and for grinding out corrugations. Ask for Bulletin 69.



This grinder is especially adapted for heavy duty work, on welded rail ends, frogs, crossings, etc. Ask for Bulletin 63.



An all-round utility grinder with its various attachments fills a long felt need for maintenance of track and switches. Ask for Bulletin 64.

WITH THE tendency toward a greater use of grinding on track maintenance, it is imperative that the proper machine be chosen for the job. Nordberg has developed three grinders just for this work. They are designed primarily to fit into the modern methods for track improvement, doing the work better and at less expense.

The use of these machines is further increased by the special attachments developed by Nordberg. They meet the requirements of each special job.

When considering grinding of rail, switches, frogs and crossings, investigate the advantages of these machines.

★

Then there are the other Nordberg Maintenance Tools, a complete line of machinery for the improvement of track....

Adzing Machine
Spike Puller
Track Wrench
Track Shifter
Rail Drill
Power Jack

NORDBERG MFG. CO.

MILWAUKEE, WIS.

No. 88 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: COVERING THE NEWS

MARCH 26, 1936

Dear Reader:

"I depend upon you to give me the facts regarding those floods, snow blockades and other disasters that strike the railways from time to time. I cannot get the details that I want, from the newspapers. You approach these developments from the standpoint of a railway man and present that information which is most directly of interest to me. And your information is accurate."

This was the comment made to me a few days ago by the chief maintenance officer of one of our large railways. It directs attention to one phase of our service to you on which we place a great deal of importance.

Looking back over the last year, this comment calls to mind the trip which a member of our staff made through the dust storms of the west last spring to gain firsthand information regarding the manner in which maintenance men were meeting the unique problems presented, where the visibility was so low that locomotive enginemen, according to report, were climbing the signal masts to ascertain whether the signals indicated "proceed." His observations were presented in our May issue.

A month later, when more than 200 miles of the main line of a western railway were destroyed by a disastrous flood, another editor hastened into this area, joining the president of this road in his first inspection of the damage to ascertain the nature and extent of the destruction and the measures to be undertaken to restore service. His observations were presented in the July issue. Again, last month we presented a firsthand story of the fight which maintenance officers on the railways in the northwest made to keep their lines open in the face of the most severe and prolonged period of low temperatures and drifting snow in this generation.

And this month we present the story of the floods which destroyed millions of dollars worth of railway property in Western Pennsylvania within the last three weeks—prepared by still another member of our staff who was in the very center of these floods during the four days when they were at their height, traveling on work trains, sharing meals with train crews, gathering snatches of sleep on office desks—and all of the time at the front where thousands of men were working with feverish haste to restore traffic on some of the nation's most important traffic arteries. For four days wet, unshaven, hungry, tired, he was constantly on the go, gathering the photographs and the information presented in this issue.

This is the life of an editor—your editor—going where things are happening, observing developments through the eyes of an experienced railway man in order that you may have the information that will enable you to visualize the problems confronting other railway men and the measures which they develop to meet these problems. This is a service of which we are proud. Is it worth while? You are the judge.

Yours sincerely,

Elmer T. Howson

ETH*JC

Editor.

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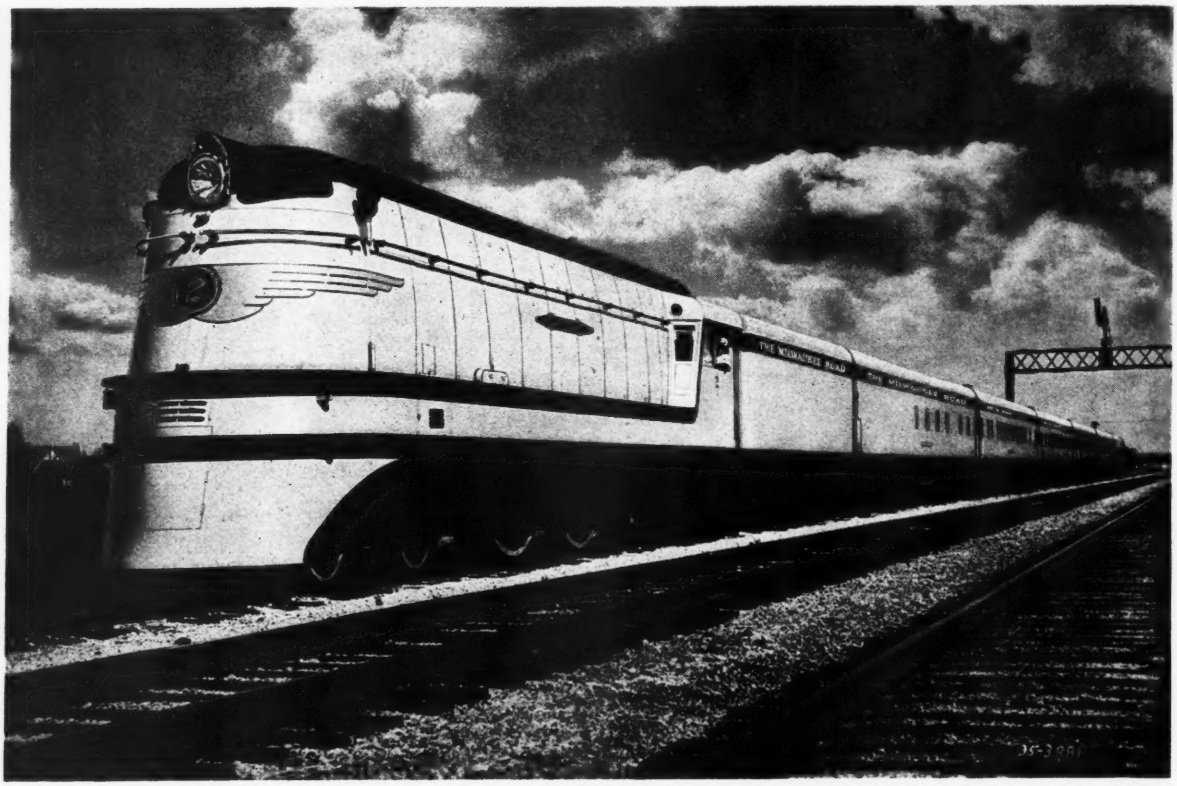

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April, 1936

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Railway Engineering and Maintenance

In Emergencies

Railways Alone Provide Service

HUMAN nature is fickle. All too commonly it turns from an agency that has served it long and well to a newer and less responsible competitor, only to find that when an emergency arises this competitor is neither willing nor able to meet the needs. Not infrequently it requires a crisis to demonstrate the superior dependability of the older agency and bring about a proper realization of its true value.

This is the situation that developed in many communities in Pennsylvania and in New England during the last month when they were overwhelmed with floods of record heights. The performances of the railways in this emergency stand out in such marked contrast with those of other agencies of transportation as not only to reflect credit on every employee involved, but also to bring to the communities affected a new appreciation of their dependence on the railways in times of dire need. This is a phase of railway service which every person interested in the preservation of the railways can well afford to emphasize.

Emergencies of Various Types

These emergencies arise in numerous ways. A year ago large areas of the western plains were swept by dust storms of unprecedented severity and continuity that made railway operation most difficult; yet they persisted in keeping their lines open and trains running under the tremendous odds then existing, while other transportation agencies gave up with little struggle. A month later a disastrous storm destroyed more than 200 miles of an important main line of one railway, which promptly threw its vast resources into the breach and reopened service in record time. A few weeks ago, the railways of the Middle West were confronted with the most prolonged and severe siege of low temperature and drifting snow in a generation but they again fought the elements and were able to maintain service, although only through the most heroic measures. Again, within the last few days, large areas in Pennsylvania and New England have been visited by record floods which resulted in heavy destruction of railway property, but as before, the railways were the first to resume service.

In all of these various types of emergencies, the railways rushed into the task of rehabilitation without a moment's hesitation. They accepted without a question the responsibility for the restoration of their lines, for it is a tradition of the railways that when service is interrupted all energies must be directed to the opening of the line, regardless of cost, in order that the public may be served. In these emergencies there is no waiting among the railways for others to assume this responsibility. It is accepted by them without a question. They comprise the only large transportation agency that so acts.

Resources of the Railways

The ability of the railways to meet emergencies is traditional. For years they have met one emergency after another until the public has come to accept such service as a matter of fact. Yet, such action is possible only because of the resources which the railways command—resources which no other transportation agency possesses.

In the first place, the railways comprise organizations with large forces of men, trained to meet emergencies. When a flood, a blizzard or a dust storm strikes, these men move to the point of trouble with a precision born of experience. The railways also possess large quantities of work equipment, of which snow plows, steam shovels and pile drivers are typical. Essential to the meeting of a crisis, such equipment cannot be procured at a minute's notice. It must be acquired beforehand and maintained ready for instant use. Indicative of the magnitude of these demands is the fact that at one time during the last two weeks the Pennsylvania had 15,000 men, 150 work trains and 76 pile drivers, steam shovels, etc., busy on flood control activities.

It was in recognition of the value of such forces and such equipment that the United States government called on a large western railway, the Southern Pacific, a number of years ago to undertake to control and return the Colorado river to its proper channel after other agencies, including the government itself, had failed. And the resources and ability of this one railway were such that the objective was accomplished and the rich Imperial Valley of Southern California was saved from further inundation.

Again, disasters such as floods, blizzards and other storms tax the financial resources of a railway. The flood on the Republican river in Nebraska last June cost the Burlington Railway $2,000,000 within the short period of 48 hours. The recent floods in Pennsylvania have cost the Pennsylvania Railroad two and one-half times that amount. The problems following in the wake

of disasters like these are not solved by weak companies with limited financial resources.

When disasters such as these arise, the crises are by no means confined to the transportation agencies. They are far more acute for the communities affected, for especially in these days of low inventories, their local supplies of such basic necessities as food, fuel, milk and even drinking water are soon exhausted and they must receive aid from outside sources. For this aid they are dependent upon transportation.

First Back in Service

In these emergencies, the highways are normally the first to go out of service. Furthermore, a few highway operators are either willing or prepared to undertake the necessary rehabilitation measures. Rather, they abandon service at the first appearance of trouble and leave it to public authorities to assume the entire burden and expense of re-opening the lines of communication, over which these private carriers operate. So it is with the airways and the barge lines, which operate only between terminals built and maintained at public expense, and at times when climatic handicaps are not too severe.

It is to the railways and the railways alone that the public must turn in crises and it should not be overlooked that in their work of rehabilitation the railways neither ask nor receive public aid. They accept their responsibility and they meet it. This is another phase of railway service which is all too seldom appreciated by the public when solicited by other transportation agencies; yet it is a phase of public service which is of very vital concern to the public.

In our February issue we urged railway employees to stress the safety of railway service. In March we pointed to its dependability. To these we now add their resourcefulness in times of emergency.

Frost Action

Has It Affected Surfaces of Slopes?

THIS is the season when sliding cuts and embankments may be expected to give the most trouble. This year, the ordinary difficulties of slipping earth and loosened rock have been increased by reason of the extremely severe winter, with its unusually low temperatures, heavy snowfall and long duration, permitting frost to penetrate to more than the average depth.

Freezing expands the soil and affects the stability of embedded rock and boulders, and often fractures both stratified and unbedded rock. When sudden thaws occur, as they have recently in many sections, the earth being loose, because it has not yet settled, is in condition to absorb more than the normal amount of water. For this reason, soil that is ordinarily stable may become surprisingly unstable and develop a tendency to slide. This tendency will be increased if a zone of frost still remains at some depth below the surface, since a plane of cleavage will be formed between the frozen earth and the saturated unfrozen zone, an ideal condition for slides.

Furthermore, stones and boulders which have previously given no concern may become loosened or actually be disturbed from their beds and crash down the hillside, an occurrence that may prove disastrous. Again, exposed ledges in rock cuts may have been affected by the frost and subsequent thawing to the extent that they have also become potential sources of danger to the operation of trains.

All of these conditions may be made worse by rainfall now or in the next few weeks. The importance, therefore, of making a careful investigation to discover places of potential danger should not be overlooked. Section foremen know the places where these troubles recur and keep a sharp watch over them. They should not stop here, however, if they have embankments, cuts or hillsides that are possible sources of slides, loosened boulders or falling rock. They should also investigate places where they have had no previous trouble, going to the top of slopes and to the foot of high embankments. Supervisors should see that they do this, and confer with them as to conditions, so that measures can be taken promptly to eliminate the danger.

Good Foremen

A Problem That Deserves Attention

IS the foreman receiving the attention he should have? A common answer to this question is that the problem is of less moment today than it has been for many years, because the reduction in the number of gangs during the last six years has created a surplus from which capable men can be selected as vacancies occur. But is it wise to assume that attitude?

Good foremen are the key to the success of any work involving the employment of workmen, regardless of the character of equipment provided for their use or of the nature of the general plan of organization that has been set up to increase the effectiveness of the general supervision. In a recent discussion of a drastic change that had been made in the organization of the maintenance of way forces on one road, the officer primarily responsible for the new plan stated that the greater output per man employed must be ascribed primarily to the higher average caliber of the foremen, since the reduction in the number of gangs had made it possible to select the most capable men from a considerably larger number than could be given positions under the new plan—and this in spite of the fact that the plan adopted embraced many other measures designed to increase the effectiveness of the men and avoid loss of time in traveling to and from their work, etc.

In a measure, this statement supports the view previously cited—that a surplus of foremen simplifies the problem of selecting capable men. But there is another side to the problem. For six years the maintenance of way forces have been drastically curtailed, so that such vacancies as have occurred have been filled by furloughed employees. This has assured an adequate supply of competent men, but it has afforded little opportunity for the infusion of new blood, which means that the average

age of both the men and the foremen has increased at a rate never before equalled in railway experience.

It is also conceded that the maintenance of way forces today, taken as a whole, are more loyal and more thoroughly experienced than has been the case for many years, but it must also be recognized that there is an age limit beyond which few men are capable of assuming positions as foremen, or of adapting themselves readily to changes in methods or to a recasting of organization such as are taking place so rapidly in these times. There is the further fact that there are available today for work on the railroads young men of far higher qualifications than could be recruited for many years in the past.

There is no ready answer to this problem. The supervisory officer, as a representative of the management, must carry out the policy of just dealing with the employee who has a long record of loyal and faithful service, while at the same time trying to offer some promise of recognition to the young man of outstanding ability. No problem confronting maintenance of way officers has a greater bearing on the future of maintenance of way operations and is, therefore, deserving of serious study.

Rail Batter

What Is the Ultimate Life of Rail?

UNTIL recently, the life of rail, except on curves, was generally determined by the rate at which batter occurred. Experience has shown that this batter does not always progress at the same rate, even under comparable conditions of traffic. For example, batter rarely occurs on the high rail on curves, whereas under normal conditions of roadbed, it not only occurs first but is usually most pronounced on the low rail.

On tangents, battering occurs earlier and is more severe on northern roads than on those in the South, this being attributed to the fact that on the former the roadbed is frozen for several months of the year. Likewise, batter is usually more severe in rock cuts, especially if the ballast is shallow and hardwood ties are used. In contrast, batter seldom occurs or is of minor importance where the roadbed crosses a swamp of sufficient depth to create a yielding subgrade. Again, it has been stated that the rate of batter is retarded by the use of canted tie plates, since they provide a wider zone of contact between the wheel treads and the running surface of the rail. It has also been observed that when the rails are interchanged on a curve, the former high rail does not batter as much in its new position as the original full-section low rail did. This can probably be explained by the cold rolling it received while on the high side. Obviously, on any given section of track the rate of batter will increase as the density of traffic and the speed of trains increase. Batter will also develop more rapidly and be more severe if the gage is allowed to become wide. Chipped ends are likely to result if the rail becomes tight.

In recent years, welding has been applied to the building up of the battered rail ends in the track, thus restoring them to their original section. Experience has also shown that if this work is done properly, the rate of batter of the reconditioned rail ends is less than that of the original rail under similar conditions. As a further step, the application of heat treatment has tended to retard batter still further, both in the original and in the repaired rail.

Still more recently, the Delaware & Hudson has pioneered in the butt welding of rails to reduce the number of joints. As experience has been gained, longer and longer rails have been produced, until last year a single rail, 6,900 ft. long, was placed in the track. So far, no difficulties have been experienced because of expansion. It is yet too early to predict what future developments these experiments will bring, but it seems safe to predict that if butt welding becomes common practice, rail will be allowed to remain in the track until it is worn out and unfit for further use, at least in main tracks.

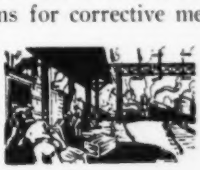
More Water

Discloses Need of Better Drainage

BY a strange coincidence, the advent of the depression was followed by a five-year period of less than average rainfall. Large areas of the American continent were subjected to an almost unprecedented drought during 1930 and 1931, and while 1932 was a year of slightly more than average rainfall, it was followed by two more years of subnormal precipitation. While the recurring periods of drought were the cause of widespread suffering, the railroads were not seriously discommoded, the reduction in the supply of water being largely offset by the marked decline in the demand that resulted from the falling off of traffic. As a matter of fact, repeated attention has been called to the fact that the depletion of ground water had stood them in good stead since it greatly minimized the influence of defective roadbed drainage on the upkeep of tracks during a period of drastically curtailed expenditures for maintenance.

But this situation no longer prevails. An increase in precipitation generally throughout the country, marked by torrential rains over large areas last summer have gone a long way to replenish much of the deficiency in subsurface water. Thus, roadbed conditions no longer compensate for inadequate maintenance and ample evidence is afforded of the need for expanded drainage operations and enlarged ballasting programs.

The extraordinary low temperatures of January and February, resulting in frost depths far exceeding those of any recent years, subjected tracks to a severe test and definitely disclosed the deficiencies in drainage. Tracks on important main lines have ridden rougher than has been the case for a long time, and it has been necessary to resort to shimming in locations where it had not been done before within the memory of trackmen now in charge. It behooves every officer of track maintenance to make the most of these evidences of defective drainage in recommendations for corrective measures.



Floods Ravage

DURING the week of March 15, prolonged rains, torrential showers and rapidly melting snow, all on frozen ground, caused floods through the Middle Atlantic and New England states, which led to widespread destruction of properties of at least a dozen railroads, including especially the Pennsylvania; the Baltimore & Ohio; the Pittsburgh & Lake Erie; the New York, New Haven & Hartford, and the Boston & Maine.

In western Pennsylvania, where the floods were particularly severe, the Pennsylvania, the Baltimore & Ohio, and the Pittsburgh & Lake Erie were the most seriously affected, the Pennsylvania alone reporting damage to the extent of approximately $5,000,000. On this road, more than 3,000 miles of lines and 8,000 miles of tracks were exposed to flood conditions, while approximately 500 miles of lines were actually under water at one time or another. On the Central region alone, approximately 315 miles of lines and 375 miles of tracks were damaged to some extent.

On the Pennsylvania

The most serious damage on the Pennsylvania occurred along its main line between Pittsburgh and Harrisburg, where inundated, washed, undermined or fouled tracks, and two complete washouts of all four main tracks blocked train movements for hours. However, possibly equally as extensive although less serious from an operating standpoint was the damage sustained between Pittsburgh and Wheeling, W. Va.; on the Conemaugh division from Conpitt Junction, Pa., to Kiskiminetas Junction, Pa., on the Allegheny river; on long stretches on its Buffalo and Williamsport divisions; and directly at and south of Harrisburg.

For the Pennsylvania, this was the most widespread and destructive flood in its history. All through the high water areas, buildings and other fixed structures, as well as tracks, were flooded and damaged. Ten feet or more of water flowed through its passenger station at Johnstown, Pa.; 6 ft. of water stood in the waiting room of the station at Williamsport, and shop buildings at many points were completely awash. At Harrisburg and at Wheeling, where exceptionally high water prevailed, the waiting rooms of its passenger stations were not flooded, but the build-

Top—On the Penna. Just West of Johnstown, Pa. Above—On the Same Road at Barree, Pa. Left—Bridges Were Endangered by Debris of All Kinds. Lower Left—Hundreds of Miles of Lines in Western Pennsylvania Were Washed or Deeply Inundated. Lower Right—Employees Were Called Into Intensive Action

Railways in the East

The Pennsylvania employed 150 work trains, 15,000 men and 76 pile drivers, cranes and other power equipment, and handled 550 cars of filling per day in restoring tracks and structures damaged east of Pittsburgh by one of the greatest floods in history. The article also reviews the destructive effect of the recent catastrophe on the Baltimore & Ohio, the Pittsburgh & Lake Erie and the railways of New England.

ings themselves were practically isolated by water which stood 4 ft. and 10 ft. deep, respectively, on the station tracks.

At several points, engine terminals were inundated, flooding coaling stations and engine houses, and ash, inspection and turntable pits. At Conemaugh, Pa., the large enginehouse was saved from complete undermining and destruction by the Conemaugh river only by the fact that four locomotives stored between it and the river, after being undercut, toppled into the river, forming a barrier or bulkhead against further serious erosion of its foundation.

At Pittsburgh, the Pennsylvania's station and main-line tracks were not damaged, but the Ohio reached an elevation 7.3 ft. higher than any previously recorded level. Hundreds of freight cars, both empty and loaded, were flooded, and water flowed through the road's large perishable produce terminal along the Allegheny river front to a depth of 8 ft. above its floor level, damaging or completely destroying thousands of dollars worth of produce and other perishables.

While it is difficult to mention those sections of the road most seriously damaged, in view of the hundreds of locations affected severely, three of the places sustaining the heaviest damage, and which caused the most serious concern because of their location in the main east and west line, were at Dornick Point, 3 miles west of Johnstown, and at Tipton and Barree, Pa., 12 miles and 25 miles respectively, east of Altoona.

At Dornick Point, in a wide swing in the Conemaugh river, a mile or more of three-track side-hill embankment was severely eroded. Wihin this area, for approximately ⅓ mile, the embankment, at least 30 ft. above the bed of the river, was eroded back to practically a vertical wall directly beneath the ends of the ties of Track 3 (that nearest the river), and for approximately 1,000 ft. this track was completely undercut and lay twisted in the river. At Tipton and at Barree, the four-track embankment was cut through by the Juniata river, leaving the tracks suspended in the air for distances of approximately 25 ft. and 75 ft., respectively, completely blocking all traffic from East to West.

At Barree, in addition, the embankment on the river side, west of the complete break in the line, had been cut away vertically for at least 2,000 ft. to a point directly beneath the outside rail of Track 1, nearest the river, and, over the same distance, the embankment had been gouged out to a depth of 10 to 12 ft., longitudinally between Tracks 1 and 2. Both of these tracks remained at grade, even though Track 1 was supported by only a narrow core wall of cemented ballast-like stone directly beneath the centers of its ties

On the Pennsylvania, repair and rebuilding operations have been on an extensive and widespread scale.

During the week of March 15, the Pennsylvania had approximately 15,000 men engaged in flood repairs. On the Central region alone up to and including March 28, approximately 998,000 extra manhours of labor had been expended on flood repair work.

Lower Left—All Four Tracks Out of Service. Lower Right—Steel Hopper Cars Protected the Embankment. Right—One Track Gone and a Second Unsafe.

The problem of securing filling materials has presented the greatest difficulties, not alone because of the quantities required, but also because of the fact that numerous industries, quarries, waste banks, gravel pits and other normal sources for such materials were themselves flooded and inaccessible. On the Central region, in anticipation of any emergency which might arise, permanent arrangements had been perfected with widely scattered sources for the delivery to the railroad of approximately 1,000 cars of filling material a day, but during this flood so many of these sources were themselves flooded out that for several days at the height of the floods, the region was able with the greatest of effort to get under load from all readily available sources, a maximum of only approximately 550 cars a day. In this predicament, the regional office at Pittsburgh reached out for filling material for many miles in every direction, ordering many loads from points as far west as Toledo, Ohio.

Coupled with the problem of getting filling material under load, was that of moving it into the damaged territories. With the floods so widespread and with so many of its lines affected, normal detour routes were in many cases not available, requiring, in some instances the most circuitous routes to get materials to the points requiring them. In spite of these difficulties, which prevailed more or less throughout the Eastern as well as the Central region, thousands of carloads of materials were dispatched to various territories with remarkable speed and effectiveness. Altogether, the Pennsylvania estimates its immediate requirements for filling material at approximately 20,000 cars.

Other requirements were likewise met with the greatest possible dispatch. Every available piece of needed work equipment on the system was rushed to the scenes of damage, ready for operation. For example, 12 crawler cranes at Wilmington, Del., were loaded and shipped by special train, with operators, to the Middle division between Harrisburg and Altoona, for cleaning fouled tracks and getting out urgently needed filling material.

Bridges Inspected

Unfortunately, the same difficulty encountered in the movement of filling materials into the flooded areas was encountered to some extent in the movement of equipment and men. For many hours, for example, high waters at and immediately east of Harrisburg made it impossible to get repair timbers, work trains, and men past that point to points west.

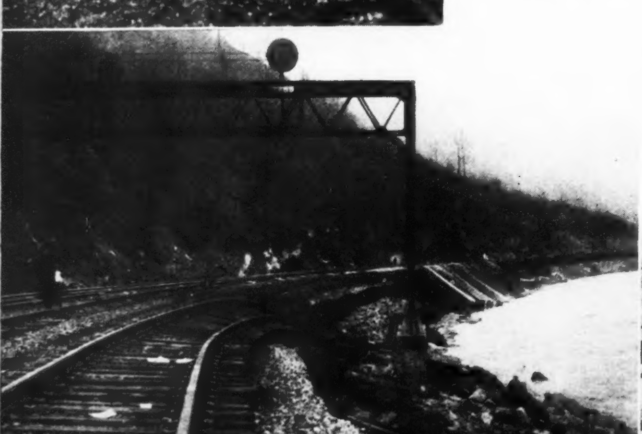
An example of the difficulty in getting on the affected lines is the experience of the bridge engineers of the Eastern region in attempting to inspect the main line bridges between Harrisburg and Altoona. A group of these engineers, under the direction of the assistant bridge engineer of the region, finally got through Harrisburg and started west, but another group under the bridge engineer of the region, seeking to inspect bridge conditions east from Altoona, reached Altoona only by traveling via New York City, Albany, Buffalo and Pittsburgh.

Everywhere on the road the utmost co-operation prevailed. Not alone among engineering and maintenance of way field and office forces, but also between these forces and those of the operating and motive power departments. Office engineers became field engineers, bridge engineers became bridge inspectors, and many supervisory officers became purchasing agents and organization specialists in the intensive search for materials, equipment and men. Power for work, wrecking, camp and material trains was furnished with the greatest dispatch. That this was no small achievement is seen in the fact that at the peak of the work there were more than 150 such trains on the road at one time.

As a result of these efforts, the east and west main line through Harrisburg, Altoona and Pittsburgh was reopened to through traffic on March 21, less than 4 days after the extensive damage; the worst gap in the main line, at Barree, being bridged by a single track late on the evening of March 20. Except directly at Barree, the road then had two or more tracks open for east and west main line service, and was striving for the immediate goal of completely reestablishing at least a three-track railroad throughout. Service on other lines was reestablished even more quickly, the line from Pittsburgh to Cleveland and other points north, for example, having been completely out of service for only a relatively short period of time.

Conditions on B. & O.

The Baltimore & Ohio, probably the second most severely damaged road, experienced repair problems almost as extensive as the Pennsylvania. Practically all the way from Point of Rocks, Md., about 42 miles west of Washington, D.C., to Etna, Pa., about 6 miles west of Pittsburgh,



Left—Water Up to the Ties. Lower Left—A Section of Main Track Completely Destroyed on the Penna. Lower Right—Two Loaded Coal Barges Blocked the Main Tracks of the P. & L.E. at Pittsburgh.

Above Left—Showing Characteristic Effect of Side Wash. Above Right—Endangered by Debris and Water Pressure This Bridge Held. Right—An Example of Complete Undercutting of the Roadbed.

a total distance of approximately 250 miles, its main line was seriously affected, with water over the tracks to various depths for a total distance of approximately 75 miles. At the same time, high water and damage were also widespread on many of its less important lines in West Virginia and Ohio, particularly that from Pittsburgh to Kenova through Wheeling, W. Va., approximately 290 miles long, which was severely damaged over much of its length by high waters, slides and embankment erosion.

Many Miles Inundated

On the 2, 3 and 4-track main line from Point of Rocks, west to Cumberland, Md., along the Potomac river, one stretch of approximately 10 miles from near Point of Rocks to Weverton, was completely inundated, the water reaching a maximum depth of 8 ft. over the tracks, while a second stretch of 25 miles, between Cherry Run, Md., and Orleans Road, was also completely under water, as much as 22 ft. at one point. With only a short gap of about five miles of dry railroad to the west of Orleans Road, still a third section of the main line, approximately 19 miles long, was submerged to a maximum depth of about 15 ft. In this last mentioned section, which includes Green Spring, W. Va., and the company's large timber-treating plant and tie storage yard at that point, the entire plant area was deeply flooded, with a loss down the river of thousands of board feet of various bridge timbers and approximately 18,000 crossties.

In the immediate vicinity of Cumberland, the railroad was not severely damaged, except for the washing out of a 30-ft. bridge at Cook's Mills, about 9 miles west, and high water generally in Wills Creek in this area. Still further to the west, however, along the Youghiogheny river to McKeesport, several other stretches of track were washed out or completely inundated, one approximately 20 miles long between Dawson, Pa., and West Newton.

Directly within Pittsburgh, the road's passenger station was high above the flood crest of the Monongahela, but huge piles of debris and battered river craft, including large houseboats, blocked its industrial branches along both sides of the Allegheny river for approximately six miles. Everything directly along the Allegheny in this area was under water to a depth of 10 to 15 ft., and hundreds of freight cars were partially or totally submerged.

Much of the inundated main line was little the worse for its wetting, but mile after mile, particularly along the Potomac river between Harper's Ferry and Cumberland, was severely damaged, with one or all tracks eroded, undermined or cut through. At a number of locations the tracks were piled high with silt and debris, and at other points they were moved far from their original alinement, a twisted wreck.

Since March 18, the general manager and the chief maintenance officers have made their headquarters at Cumberland, inspecting damage, correlating repair efforts, and ordering materials, equipment and supplies from first hand knowledge of requirements. In many cases, special requirements have been relayed back to the general offices at Baltimore, where a special organization was set up in the general manager's office under the assistant general manager, and still continues to function, to expedite purchases and shipments.

Using every known means of track restoration and availing itself of every opportunity to cut sections of undamaged tracks into other sections of undamaged tracks, running around places requiring the greatest amount of work, where possible, the B. & O. re-established main line service at a rapid rate, the first through service between Chicago and Washington being re-established, without off-line detours, on Sunday, March 22, five days after the occurrence of the most serious damage. By the night of March 23, the road had double-track or better in operation at all points between Washington and Chicago, except at Cook's Mills, where only a single track was in service.

Damage on the P. & L. E.

The Pittsburgh & Lake Erie was less seriously and less extensively damaged than the Pennsylvania and the Baltimore & Ohio, although many miles of its lines were under water and it suffered much washed track and a number of serious washouts. Directly at Pittsburgh, and for about 13 miles in each direction, its tracks were continuously under water to a maximum depth of 10 to 12 ft. Its passenger station, power and heating plant, and extensive freight warehouse facilities at Pittsburgh, directly alongside the Monongahela river, and subject to backwater from the Ohio, immediately below, were flooded with seven feet or more of water.

About a mile downstream from the station, two large steel river barges, each 175 ft. long and 26 ft. wide, and

(Continued on page 236)

Ten Men Prepared the Bed to Receive the New Ties and then Used Tie Tongs to Pull Them into the Track

Special Gangs Reduce Cost of Tie Renewals

With a view to reducing the unit cost of track maintenance, the Chicago, Milwaukee, St. Paul & Pacific follows the practice of doing as much track maintenance as practicable with large gangs which can be fully mechanized. This article describes the methods followed by one tie-renewal gang, which is typical of those followed by 25 similar gangs employed on the system during 1935.

WITH a view to the complete mechanization of its larger maintenance operations, it has been the practice of the Chicago, Milwaukee, St. Paul & Pacific for several years to employ system gangs fully equipped with power machines and tools for such work as laying rail, ballasting, tightening bolts, building up and heat treating rail ends, etc. Extending this practice, it has proved to be equally economical to employ similar gangs on the various divisions for renewing ties and general surfacing.

Three principal advantages are claimed for this method of making tie renewals. No other maintenance operation calls for so many individual items of work or requires the use of so many different tools as the renewal of ties. When a small gang is engaged in renewing ties, each man must of necessity do several things, such as pull spikes, clean out the cribs, remove tie plates, move ties, pull out and insert ties, replace tie plates, spike, gage, tamp and line. When he finishes one of these tasks, he commonly drops the tool he has been using and walks back to the last point of use for the next one he requires. The result is that a large percentage of his time is unproductive.

Where the larger gangs are employed, each man is assigned to a particular task for the day, so that he needs only a single tool which he retains throughout the working period. Since these gangs do no other work than that to which they are assigned, the men soon become proficient in their allotted tasks, while it is comparatively easy to iron out any inequalities in the organization, so that the productive output per man can be brought to a higher level than in a gang that is compelled to shift from one job to another at short intervals. Furthermore, as these gangs are put on early in the year and are continued

until the close of the season, or until the scheduled work is completed, maximum use of the power machines which are assigned to them is assured.

A section gang is usually of such size that the saving it can effect through the use of the larger power units is limited. Furthermore, section gangs have a wide variety of tasks to perform, for which reason they can seldom devote enough time to the work for which any one type of equipment is designed to pay the carrying charge on that equipment while it is in their hands.

Twenty-Five Gangs

It was these considerations which led the Milwaukee to make a study of the advantage of larger gangs for renewing ties, and which finally resulted in the organization of special gangs. Twenty-five gangs of this type were engaged in renewing ties during 1935; some of them also did a considerable amount of other maintenance work in addition to tie renewals. Five of them were primarily maintenance gangs and while they renewed a large number of ties, the tie renewals were largely incidental to their other work.

Circle—Renewing the Angle Bars. Center—Pulling Spikes. Right—Cleaning the Cribs

These 25 gangs employed an average of 2,266 men daily during the season. Three of them were employed in terminals where much or all of their work was in yards. The largest gang, primarily a ballasting gang, employed an average of 321 men throughout the season. Up to August 31, it had worked over 281 miles of track in which 169,000 ties were renewed. The remaining gangs, ranging from 27 to 122 men, were organized specifically as tie-renewal gangs, although most of them did considerable other work in connection with the tie renewals. The total number of ties inserted by these 25 gangs to August 31, when most of them had completed their schedule, was 1,363,733, covering 2,740.5 miles of tracks. In addition 92,797 ties were inserted in side tracks other than those in yards.

While this appears to be a high rate of renewal, averaging 498 to the mile on the territory involved, it is explained by the fact that some years ago, for several seasons, loblolly-pine ties treated with zinc chloride were used in renewals, and these ties are now failing in large numbers. For this reason, tie renewals this year have been exceptionally heavy and practically all of the ties removed, except on the Coast and Terre Haute divisions, were of this wood and treatment, and many of those on the latter division were of this type.

In preparing its track for high-speed train service between Chicago and the Twin Cities, the Milwaukee made a special study of curves and of the approaches to curves. The results of the system of spiraling and approach elevation adopted for this high-speed line have been so satisfactory that the same treatment is being given to all curves on the system as it becomes necessary to make a heavy renewal of ties or give the track a general surface. Furthermore, where the track is being overhauled, such joint bars as are worn are replaced with new or reformed bars. For these reasons it has been necessary for these gangs to do considerable incidental lining and surfacing and joint maintenance not ordinarily included in a tie-renewal program.

One of these gangs, typical of all except those in yards and those engaged primarily in ballasting, averaging 108 men for the season but varying somewhat from this average from time to time, was assigned to the Terre Haute division, a double-track freight line extending from Chicago to the coal fields of Southern Indiana. Starting on June 3 and continuing to August 31, a total of 78 working days, this gang completed renewals on 112.6 miles of track, including the insertion of 79,683 ties, the renewal of angle bars on much of this mileage, the application of tie plates to all unplated ties and a large amount of general surfacing and lining of curves.

Unloading

No preparatory work was required in advance of the gang, except the staking of the curves and the unloading of the ties, both of which were kept several miles ahead of the gang. For unloading ties, the section gangs, which normally consisted of a foreman and 3 men, were increased to 8 men as the work progressed, and automatically dropped back to a foreman and 2 men when the tie gang passed from the section. These enlarged section gangs not only unloaded the ties, but also spotted them ready for insertion

An original inspection to determine the tie requirements had been made the previous autumn, but as a check, a second inspection was made in the spring, at which time every tie to come out was indicated by a mark on the rail. So carefully was this inspection made that there was no shortage of ties at any time, and few were left over.

Left—Removing Old Ties. Right—Pulling New Ties into Track

Ties were unloaded from two cars at a time, while the train moved forward slowly, one man on the ground checking the marks on the rail and indicating how many were to be unloaded in each panel. Where the renewals were light the unloading was done carefully from both cars. Where they were heavy, the men in the first car unloaded without restriction, and the number required per panel was completed from the second car.

Renewals Heavy

With a few minor exceptions all of the work done by this tie gang was on the southbound track which had been built as a second track in 1923, before the line was acquired by the Milwaukee. The original ties were untreated and were 6 in. by 8 in. by 8 ft. in dimensions. The ballast was gravel with a rather heavy shoulder and with the inter-track space filled to the top of the ties. During the 12 years since the track was completed some of the original ties had failed and been replaced in kind. Even some of these later ties were ready for renewal by 1934, since a considerable number were the loblolly-pine, zinc-treated ties, and last year 109 miles of this track was given an overhauling, the work this year being a continuation of that started in 1934. The result was, however, that while the renewals were fairly heavy on every mile they were quite irregular, ranging from 350 to 400 on some miles, with a few miles as low as 200, to 1,200 or more on others. All ties inserted by the tie gang were 7 in. by 9 in. by 8 ft. 6 in. They were treated with a petroleum-creosote mixture and were bored and adzed at the treating plant of the Indiana Wood Preserving Company at Terre Haute, Ind.

Preceding the tie-renewal, 28 to 30 men, forming a single unit under an assistant foreman, applied new angle bars out of face. At the head of this unit, 4 men with wrenches removed all good heat-treated bolts, always leaving at least one bolt in the joint. One man followed pulling the joint spikes and another man then removed the remaining bolt if it was fit for further use. Four men with chisels and sledges then cut the nuts on all worn and frozen bolts, removed the angle bars and adjusted the expansion, following which one man painted the rail ends with oil.

This track had been laid with 80-lb. rail, drilled for 1-in. bolts, althought 7/8-in. bolts had been used originally. When it was laid, a greater expansion allowance had been provided than was necessary, so that in adjusting the expansion to the Milwaukee standard the take-up averaged about 18 in. to the mile. For this reason, it was necessary to provide a car, operated by one man, to run ahead of the four men who adjusted the expansion, to carry tools for their use, as well as new bolts, oil for painting the rail ends and extra rails for use when the take-up gap became too wide.

Following the adjustment of the expansion and the oiling of the rail ends, four men with high-speed wrenches placed the new joint bars and ran the nuts up as far as this could be done with the short-handled wrenches without too much effort. Three men with long-handled wrenches then tightened the bolts to the desired tension, using mauls to tap the bolts and base of the angle bars to insure a tight fit. This unit was able to apply an average of 341 pairs of joints in eight hours.

Included in this unit, two men distributed anti-creepers and gathered up the discarded bolts, segregating the worn and usable bolts in separate piles for the loading unit. One man applied joint tie plates to all joints, even where the joint ties required renewal, to insure an adequate bearing for the passage of trains until the arrival of the tie renewal unit, and two men respiked the joints. The last man in this unit was a special flagman, who was in addition to the flagman employed to protect the remainder of the operation.

While the number of men in the first unit was normally from 28 to 30, at times this number was increased considerably. Progress for the gang as a whole was almost uniformly from 900 to 1,000 ties a day, regardless of whether the number applied per mile was large or small. When the renewals were heavy, say 400 or more to the mile, the track was lifted about 2 in. If they were less than 400 they were spotted in. For this reason, the number of men in the tie renewal unit also varied. The average rate of applying the new joints was slightly more than a mile a day. When the number of ties to be renewed dropped below about 700 to the mile it became necessary to increase the number of men engaged in replacing joints in order to keep ahead of the tie gang, and the required force was transferred from the latter unit. This flexibility permitted the whole operation to move along smoothly at a uniform rate based on the number of ties inserted day by day.

Two methods of making the tie renewals were followed, depending

on the number required per mile. Where the renewals ranged from 400 to 450 per mile, or less, the ties were dug in and the track was not surfaced, except to tamp the new ties, pick up low spots and low joints and correct irregular cross level. Where the renewals were heavier, the track was lifted about 2 in. and was given a complete surfacing. Also, the approaches to curves and the curves themselves were lined and surfaced, regardless of the number of ties to be renewed.

In the first case, 2 men were assigned to pull the spikes from the ties that were to come out, and from 14 to 16 men cleaned out the cribs and removed the shoulder ballast from the ends of the ties. After the cribs were cleaned, 2 men with jacks sprung the rail enough to permit 3 men to remove the tie plates and pull out the ties without disturbing their bed. As soon as the ties had been removed from the track, 10 men, in pairs, prepared the bed to receive the new ties and inserted them. One man then refilled the cribs in preparation for the surfacing gang.

The surfacing gang, consisting of 8 tampers and 1 generator operator, was equipped with an 8-tool electric tamping outfit. The generator was mounted on wheels, and the operator pushed it along the track as the tampers moved forward. Following the tamping, two men inserted the tie plates. For this purpose they used two 12-in jacks to spring the rail sufficiently to permit them to slide the plates in place by hand, thus avoiding the necessity for driving them. Immediately behind these men, 8 spikers gaged the track, where necessary, and spiked the new ties. A small group, varying from 2 to 6 men as required, followed, filling in the cribs. Where the new alinement of the curves or approaches required considerable throw, although this seldom exceeded 12 in. on the approaches or 3 in. on the curves, the lining was done in advance of the surfacing, and the finished lining followed.

Heavy Renewals

Where the renewals were greater than 450 to the mile, the track was given a lift of about 2 in. This necessitated some shift in the assignment of the men in the tie renewal unit and some changes in the sequence. As before, 2 men pulled the spikes, although at times 4 men were required. One man cleaned the ballast away from the ends of the ties, and 2 men lifted the track with jacks enough to permit the ties to be pulled out without cleaning the cribs. Four men with picks pulled out the old ties while the track was held by the jacks. As soon as the ties were out, the jacks were removed and the track dropped back on its bed.

The same 10 men as before prepared the bed and inserted the new ties and 2 men followed, placing the tie plates. Eight spikers and 4 nippers then gaged and spiked the track ahead of the tamping instead of following it as in the first instance. The tamping outfit and method were the same as where the renewals were lighter, except that the track was given a running lift of about 2 in. with a spot board, 2 jackmen being employed in both cases. Six men followed the tamping outfit to fill in the cribs.

Regardless of whether the renewals were heavy or light, 4 men piled the old ties for burning and assembled the few new ties that were left over for loading or transferred them across to the northbound track if they were needed for renewing ties in that track. Also, a unit comprised of 12 men followed the filling of the cribs to give the track the final line and dress the ballast. Wherever the ballast section was scant, new ballast was unloaded to fill it out. As has been stated, however, this track had a rather heavy ballast section, so that an average of only 205 cu. yd. of new ballast was required per mile, a considerable part of which was employed in connection with the lining of the curves and approaches.

Additional Men

In addition to the men assigned specifically to the several units, 2 men with a push car distributed new spikes, picked up all scrap and sorted the usable and scrap spikes. Two water boys served all units. One tool man collected tools that had been dropped and left behind and redistributed them to the respective units. One motor car operator handled the motor car and trailers that were used for transporting the men between the camp and the site of the work.

It will be noted that the foregoing accounts for only about 80 to 90 of the men comprising the gang. In carrying out an operation of this magnitude the necessity constantly arises of shifting men to or from some of the units as they lag or advance out of synchronism with the operation as a whole. For this reason, only the normal composition of the various units has been given, and no account was taken of the in-

Left — The Surfacing Gang. Circle—Inserting Tie Plates. Below—Gaging and Spiking Unit.

creases or decreases that became necessary to keep the individual units in step with the remainder of the operation.

It has been the experience of the Milwaukee that in any mass operation requiring a gang of this size, ample supervision pays for itself in lowered costs, in greater output per man-hour worked and in work of better quality. For this reason, while the work was done under the direct supervision of the district roadmaster, the gang organization included 1 general foreman, 2 foremen and 2 assistant foremen.

Maintenance officers of the Milwaukee have recognized that one of two results must be obtained from an organization of this kind to justify its existence. It must either do as good work at lower cost than can be obtained by some alternate method, or it must do better work at the same or a lower cost. As has been explained, the quality of the work has been assured by providing ample supervision, so that every item of the operation will be directed by competent trackmen.

Very careful records of cost have been kept, which for the purpose of this presentation have been reduced to both a unit and an average mile basis. These figures include only those items which were connected with the renewal of ties, for which reason all material costs and the cost of applying the angle bars have been excluded, but the lining of the curves has been included although this was not an essential element of the cost of renewing the ties. These figures include the work train costs for unloading ties, unloading ballast, picking up scrap and moving the camp cars as the work progressed. They do not include rental for the camp cars or the carrying and maintenance charges on the motorcar or tie tamping equipment.

Included in the foregoing cost figures is the time lost during the passage of trains. In addition to the 79,683 ties inserted in the main tracks, and not included in the foregoing cost figures, 16,462 ties were inserted in sidings.

These gangs have been organized and their work directed under the general supervision of W. H. Penfield, chief engineer, and Wm. Shea, superintendent of track maintenance. The work which has been described was under the direct supervision of E. Schoech, roadmaster. E. Thompson was general foreman.

Cost of Renewing Ties and Related Items

General	
Average number of men in gang	108
Number of days worked, including time lost from weather, etc.	78
Kind of ballast	Gravel
Number of track miles completed	112.6
Ties	
Number of ties inserted	79,683
Average per mile	708
Cost per tie to unload	$ 0.0159
Cost per tie to insert	0.1649
Total cost per tie for unloading and inserting	0.1808
Total cost per mile for unloading and inserting ties	128.01
Ballast	
Total amount used, cu. yd.	23,100
Average per mile, cu. yd.	205
Cost per cu. yd. to unload	$0.0078
Cost per mile to unload	1.60
Tie plates (new)	
Number applied	122,379
Cost per mile to apply	$5.22
Anti-creepers (new)	
Number applied	18,385
Cost per mile to apply	$1.38
Surfacing, lining, etc.	
Cost per mile to surface	$35.04
Cost per mile to line and dress	31.14
Cost of work train per mile	5.58
Summary	
Total cost of labor per mile	$202.39
Work train per mile	5.58
Total cost per mile	$207.97
Cost per tie, labor (including surfacing, lining, applying tie plates, anti-creepers, etc.)	$ 0.2858
Cost per tie, work train	0.0078
Total cost per tie	$ 0.2936

What Is Blue Stain in Lumber?*

By Theodore C. Scheffert†

BLUE stain in lumber, also commonly called "sap stain" because it is typically confined to the sapwood, is due to the presence in the wood of minute thread-like fungi, which are low forms of plant life. Decay of wood is also caused by fungi, but of a different kind, which affect the wood in a very different manner. Blue stain is not the result of a "souring" or "fermenting" of the wood as many suppose, nor is it an early stage of decay.

Mature blue-stain fungi are dark colored and it is the mass color of these organisms, as seen through the surface layers of the wood, which we see and recognize as blue stain. Often some of the fungous "threads" appear on the outside of unsurfaced boards, as dark mold-like growths. Once established, blue stain cannot be removed. Surfacing of the stock is usually of little value since the discoloration generally extends to the interior of the boards. Blue stain is spread by the growth of the stain fungi from infected to bright material, or by the fungous spores or "seeds" which are blown by the wind or carried by insects from infected timber to bright wood.

From a utilization standpoint, the objectionable features of blue-stained lumber lie largely in its appearance, its suitability for uses where appearance is not a factor being for the most part unimpaired. Its painting and gluing qualities appear to be comparable to those of bright wood. Contrary to the opinions of some, tests have indicated that blue stain does not interfere with the penetration of preservatives. The effect of blue stain on the strength of wood is disputed. Preliminary experiments conducted at the Forest Products Laboratory indicate that heavy stain may cause some weakening. However, so far as is known, whatever strength reduction there may be does not render the wood unfit for ordinary purposes where strength is not a prime requisite.

Despite the suitability of blue-stained wood for many purposes there is a growing prejudice against it. Many people believe that blue stain is a stage of decay. That this is not the case has been pointed out. Nevertheless, conditions which favor the development of blue stain also favor decay. For this reason stained wood should be examined for the presence or absence of decay if it is to be used where comparatively sound wood is called for.

Control of blue stain depends on control of the fungi causing it. For these fungi to develop, the sapwood supporting them must contain water

* This discussion was submitted for publication in the What's the Answer department of the February issue, but because of its scope it was withheld for presentation here as an independent article. For further discussion on this subject see page 93 in the February issue.

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in amounts equal to at least 20 to 30 per cent of the dry weight of the wood. This is about the range of moisture content at which lumber begins to shrink when seasoning. Furthermore, the temperature of the wood must be favorable. However, if the lumber is treated with chemicals which poison or otherwise prevent fungous growth, blue stain cannot occur, regardless of whether the wood is otherwise suitable.

Control of blue stain by regulating the temperature of the wood is ordinarily impractical. Control by rapid reduction of the moisture content during seasoning is practical, however, and this method is customarily employed, either alone or supplemented by chemical treatments. Special seasoning practices such as kiln drying, steaming, end racking and crib piling are designed not only to dry the lumber more rapidly for quicker turnover but also to reduce the occurrence of blue stain and similar defects. Seasoned wood is still subject to blue staining if it becomes wet.

To avoid the expense of special air-seasoning methods for stain control and also to decrease the wide variability in results obtained, chemical surface treatments have been devised for lumber, which greatly reduce the blue-stain hazard for ordinary air-seasoning procedures. These are generally applied by passing the freshly sawed lumber through vats containing water solutions of the chemicals. Hot soda solutions have been used commercially for this purpose, but on pine only. Recently more effective treatments, suitable for hardwoods as well as pine, have been developed by the United States bureau of plant industry, in co-operation with the forest service and certain chemical companies and interested lumber organizations. These treatments, applied in cold solution, are now in use by most of the larger lumber companies of the South.

Taking Up Wear on Bridge Pins

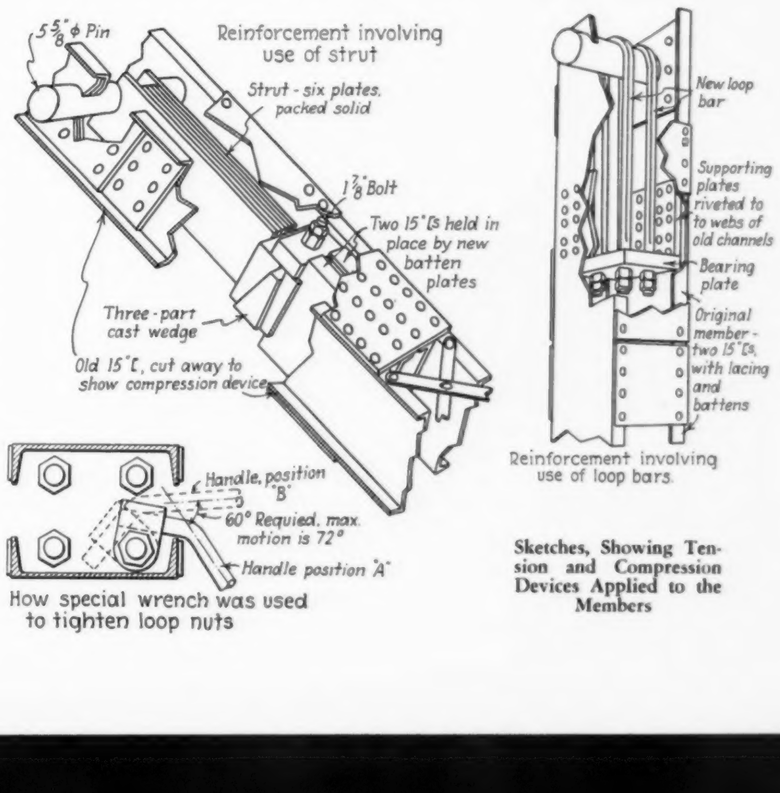
Novel method of eliminating play in pin holes, with means of providing adjustment on both tension and compression devices, was developed for use on old through-truss bridge of the Louisville & Nashville over the Clinch river.

INGENIOUS details were employed in developing means for taking up the wear in pins and pin holes in two old through truss spans of Bridge 86, across the Clinch river, on the K. & A. division of the Louisville & Nashville. These two spans are single-track through pin-connected Pratt truss spans built in 1904, being designed for two 170,-000-lb. consolidation locomotives (approximately equivalent to Cooper's E-40 loading). Continual service under traffic considerably heavier than this had resulted in wear in the pin connections of certain of the web members that permitted a movement of the pins in the pin holes of 1/4 in.

This wear was the result of movement occurring with the reversal of stresses in the members, the wear being intensified as the amount of play increased. The task, therefore, was to introduce devices into the ends of these members that could be brought into tight bearing against the pins on the side opposite that which was in bearing against the member itself under the greater of the alternate stresses. In other words, a tension device was introduced where the member was normally subjected to compression, and a compression device in members normally subjected to tension. In the instances whre the added devices were required to resist tensile forces, the familiar expedient of loops around the pins was adopted. Where the added devices were required to resist compressive force, a built-up strut was inserted inside the member and brought to bearing against the near side of the pin.

An important feature of the design of these devices was the means of insuring a tight fit and of permitting of ready adjustment to take up any further wear in the future. In the case of the loop bars, this was done through the agency of nuts bearing on a heavy plate that was provided with a suitable support on the member, while in the case of the struts it was necessary to employ wedges. However, the means of transferring the stress from the loop bars and the struts to the members had to be worked out to suit the design of the members.

All of the members involved consisted of pairs of 15-in. channels connected by lacing and batten plates, with the flanges turned out for the diagonal members and turned in for the posts. The channels of the diagonals were separated far enough to permit the introduction of double diaphragms consisting of two short lengths of 15-in. channels that were attached by means of batten plates riveted to both the diaphragm channels and



Sketches, Showing Tension and Compression Devices Applied to the Members

the two main channels. In posts requiring compression devices the necessary support was provided by a diaphragm consisting of a single plate 1½ in. thick that projected beyond the sides of the member and was attached by means of pairs of angles on the outside of the channel flanges. The nut-bearing plates of the tension devices were supported on heavy plates riveted to the inside faces of the channels in the posts.

The compression devices were equipped with three-part wedges as indicated in the sketch, the middle member being provided with a hole to take a 1⅞ in. bolt that can be drawn up by turning a nut. As this nut is located outside the member it is in a convenient position for turning. But this is not the case with the nuts on the U-bolts, which are located inside the posts, and as these have the flanges of the channels turned in, it was impossible to use any ordinary type of wrench. This led to the design of a special socket wrench manipulated by a curved bar as shown in the small sketch.

The general type of construction adopted, aside from the desirability of providing adjustment, was developed with a view to meeting the requirement that the lacing system of the compression members must be maintained without interruption. This latter requirement was the major reason for placing the devices inside of the members, but this location also leaves the appearance of the members practically unchanged, which was an added factor influencing its adoption.

After erection, the U-loops and wedges were adjusted sufficiently to bring the pins in firm contact with the original pinhole on one side. No attempt was made to adjust the initial stresses in the devices with an extensometer, the adjusment being approximately limited to stresses predetermined from calculation, by limiting the effort applied to the end of the wrench used in tightening the nuts of the adjustment bolts. After installation, no movement of pins relative to members could be detected. It is the intention to make a readjustment after the device has been in service some six to nine months, to take up any pin play that may develop due to the smoothing out of any irregularities in the pin bearing surfaces that may have existed at the time of erection.

This plan for taking up the wear in these pins was developed by C. K. Bruce, assistant bridge engineer of the Louisville & Nashville, under the direction of J. M. Salmon, bridge engineer and G. R. Smiley, chief engineer.

Floods Ravage Railways

(Continued from page 229)

each loaded with 850 tons of coal, and weighing approximately 180 tons each when empty, floated onto the tracks and blocked all three main tracks. Left on the tracks on Thursday, March 19, they defied all efforts to remove them up to Saturday evening, March 21, except that one barge, which alone blocked the third main, had been emptied, jacked up on rollers, and with the aid of the winches of a large river boat and a wrecking crane, had been slewed sidewise sufficiently at one end to clear the third main track. With an auxiliary track alongside, this provided two clear tracks for through movement over the railroad at this point. Final removal of the barges, it is expected, will require cutting them in sections with acetylene torches.

At Coraopolis, Pa., about 10 miles west of Pittsburgh, the main line was flooded with thousands of gallons of gasoline as two 10,000-gal. gasoline tanks were unseated and emptied over the railroad. This caused no damage to the tracks, but it interfered seriously with the movement of work trains and the movement of filling material since it was unsafe for many hours to allow locomotives with live fires within several thousand feet of the affected area. To get cars past this area, they were coupled into long trains and pushed over it, a second locomotive at the opposite end of the area then pulling them away. In this manner, the locomotives at both ends were kept far from the dense, highly inflammable gasoline fumes.

In New England

While floods were ravaging the railways of the Middle Atlantic states, the New England states were also suffering high water and destruction. The roads most seriously hit were the New Haven, the Boston & Maine and the Boston & Albany. On the New Haven, practically all of its lines, other than its main lines, were affected by high or rapid, eroding waters, and the main line did not escape high water and some damage between Hartford, Conn., and Springfield, Mass. Altogether, approximately 20 miles of tracks were damaged to some extent, including, in addition to wash and embankment shoulder erosion, at least 15 major washouts and 45 washouts of a less severe character.

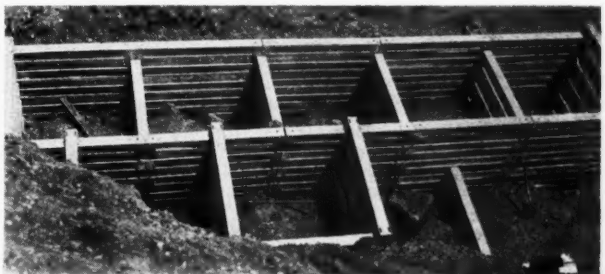
The most severe damage was caused by the Connecticut river, which started a second rise within a week on March 18, reaching a level at Hartford 6 ft. above the previous maximum, on March 21. This road suffered damage to several bridges, including the loss of three spans of its bridge at Turners Falls, Mass., and damage to its trestle at East Hartford, Conn., and also sustained considerable damage to shop and terminal facilities and equipment at Springfield and Hartford. However, by Saturday, March 28, the New Haven had resumed train movements on most of its lines, and reported repair work approximately 90 per cent completed. In this repair work, it had to that date employed approximately 12,000 cu. yd. of two-inch stone; 5,000 cu. yd. of rip rap; 22,000 cu. yd. of cinders, and a considerable amount of timber, including that for the construction of about 150 lin. ft. of trestle. Twelve work trains, 4 cranes and shovels, 1 pile driver, and approximately 250 men have been employed in the repair operations. The cost of repair work on the New Haven is estimated at from $150,000 to $200,000.

Various lines of the Boston & Maine, following many streams in New England, were flooded and damaged extensively, with severe washouts and embankment erosion at many points. The most serious damage occurred on the main line between Lowell, Mass., and Concord, N.H.; between Eastside, N.H., and Concord; between White River Junction and Wells River, on the Wells River-Springfield, Mass., line; at a few isolated points on both the eastern and western routes of the Portland division and on the Fitchburg division; and on several secondary lines.

Concentrating large forces on the most severely damaged sections of main tracks, practically all of these tracks had been repaired and put back in service by Thursday, March 26, with the major exceptions of the section of the line between Lowell and Concord, and a short section of line between Eastside and Concord.

Metal Cribbing Saves Failed Tail Wall

WHEN ONE of the tail walls of a concrete bridge abutment on a railroad in Ohio began to show signs of failure recently, the necessary support for this wall and the affected embankment was provided by the installation of a retaining wall of metal cribbing. The abutment involved, which is about 30 ft. high, is of the semi-buried type with two cantilevered tail walls parallel with the track that support the roadbed behind the back wall to the point where the slope of the end of the fill reaches the roadbed level.



Left—The Lower Part of the Wall Is Two Cribs in Depth

Right—View of the Erection Operations—Note the Failed Wall

Left—A Bridge Gang of 10 Men Erected the Crib Wall

Right—View of the Crib Wall as it Neared Completion

Failure of Tail Wall

Owing to the sliding or settlement of the end slope of the embankment, one of the tail walls was subjected to excessive lateral pressure with the result that cracks developed at its connection to the shaft of the abutment. A study of the conditions led to the conclusion that the most practical means of preventing further damage was to fill out the nose of the embankment sufficiently to develop lateral support for the tail wall.

However, owing to the presence of a farm road under the bridge it was necessary to do this without extending the toe of the slope beyond the face of the abutment. Accordingly it was decided to construct a wingwall extending laterally in line with the face of the abutment, and Armco metal cribbing was selected for its construction.

The crib wall, which was constructed with the same batter as the face of the abutment, is 30 ft. long and is stepped down from a maximum height of 28 ft. 8 in. adjacent to the abutment to a height of 11 ft. 2 in., at the outer end. The lower part of the wall is two cribs or cells thick while the upper part is one cell thick.

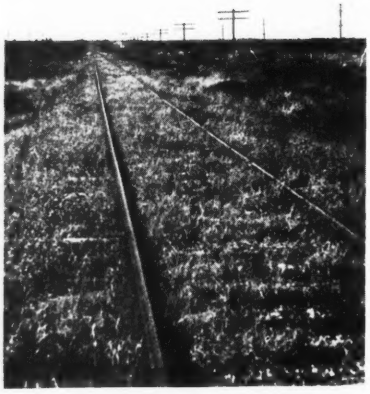
The crib-wall units used are of the standard Armco type, the headers being 6 in. square in section and 6 ft. long, while the stretchers are 8 in. deep, 6 in. thick and 8 ft. long. The header and stretcher units weigh 39 lb. each. They are closed on the top and sides and open on the bottom while suitable diaphragms are riveted into the ends and at several intermediate points.

Effective Connections

Each header is connected with the stretchers of the course below through the agency of projecting flanges or lugs on each side which have bolt holes that match corresponding holes in the top faces of the two stretchers. The stretchers in the course above are secured to the header by means of depending flanges on the end diaphragms in the stretchers, which are inserted through slots provided in the top of the header. When the stretchers are seated on the header, holes in these flanges match with holes in the two sides of the header and in a gusset plate inside the header, after which a long bolt is pushed through the assembly from one side and the nut applied on the other.

The back-filling, which was tamped in place in layers, consists of unwashed pit-run gravel. Care was taken to exclude all cinders from this material. The crib-wall was erected by hand by a bridge gang of 10 men, which was assisted in the excavating and back-filling operations by a section crew of 8 men. A careful inspection of this wall a number of months after it was constructed disclosed no signs of settlement or deviations from the original alinement.

Branch Line Problem



Track on the Wichita Valley Before Being Worked Over

A Section Gang at Work on the Wichita Valley

Typical Track After It Has Been Put Up

THROUGH the development of a maintenance organization that has enabled the railroad to obtain a more effective use of its maintenance dollar by making possible a larger output of constructive work per man employed, the Ft. Worth & Denver City (the Texas unit of the Burlington Lines) has succeeded in bringing about a marked improvement in the physical condition of its light traffic branch lines while at the same time effecting a substantial reduction in maintenance expenditures. Essentially the new organization comprises greatly lengthened sections and correspondingly larger section gangs and involves the employment of a patrolman for each section, who functions both as a track inspector and as a one-man gang for handling spot work and other minor tasks. First installed experimentally on a limited mileage in 1932, the plan produced such excellent results that subsequently it was applied on all the company's branch lines, totalling 583 miles, in addition to a 117-mile district on the main line, a total of 700 miles of line.

Early Economies

During the early stages of the depression, the F.W. & D.C., in common with most railroads, sought to bring maintenance expenses in line with declining traffic and revenues by decreasing the number of section laborers without changing the length of the sections. As this policy was continued, the section forces on branch lines were eventually reduced to the point where the typical section gang consisted of the foreman and two or three laborers during the working season and, quite frequently only the foreman during the winter months. Obviously, little heavy maintenance work, such as out-of-face surfacing and tie renewals, could be expected of the reduced section gangs, and, therefore, their activities were confined largely to spot work and patrol duty.

With this organization in effect, the physical condition of the tracks and roadbed declined steadily. It was becoming evident, moreover, that, owing largely to competition on the highways, there was little prospect that sufficient improvement in branch line traffic would take place in the near future to warrant the restoration of the section gangs to their original size. By 1932, therefore, it had become clear that if the deterioration of the branch line properties was to be arrested and some of the deferred maintenance was to be replaced, without a corresponding increase in maintenance expenditures, a permanent reorganization of the track forces on a more efficient and economical basis would have to be effected.

In 1932 the Ft. Worth & Denver City installed experimentally a new type of branch-line maintenance organization based on greatly enlarged sections and correspondingly larger section gangs. So successful was the plan in reducing maintenance costs and improving the physical condition of the properties that it was subsequently extended over 700 miles of line, including a 117-mile district on the main line.

In seeking a solution to the problem thus presented, one of the first aspects of the existing maintenance organization to come under scrutiny was the ratio of the cost of supervision to the expenditures for productive labor. As the rate of pay for foremen was practically double that of laborers and as there was a foreman for about every two laborers, it was evident that the ratio was unduly large. In view of this situation it appeared that the most promising possibilities for obtaining the desired results involved a reduction in the number of foremen and the hiring of additional laborers with the savings thus effected.

Accordingly, after careful study, a plan for a maintenance organization was developed that appeared to meet all the requirements of adequate track maintenance at a cost not exceeding that of the skeleton organization then in existence. Un-

Solved by Longer Sections

der the new plan the length of the sections was to be increased from an average of about 10 miles to more than 30 miles, the section gangs were to be consolidated and augmented by the number of additional laborers that could be employed with the savings effected through the elimination of track foremen, after allowance had been made for the wages of a track inspector for each enlarged section, who was to be paid a rate equivalent to that of assistant foreman.

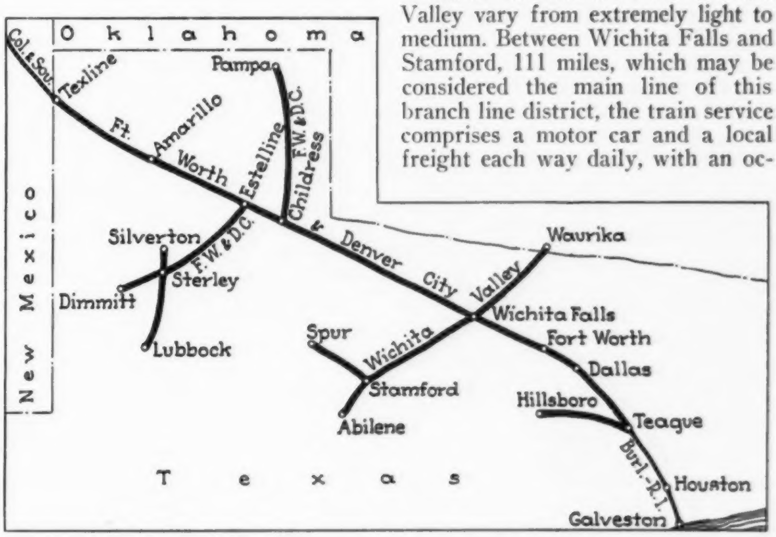
The plan for the new organization also contemplated that the work be carried out in a somewhat different manner than under the old system. So far as possible the section gangs were to spend their entire time "putting up" the track out-of-face, that is, renewing ties, giving the track a light surface, oiling the joints, etc., while the minor and widely scattered tasks, such as the adjustment of switches, the removal of weeds from around bridges and company buildings, the spotting up of isolated low joints and general inspection duty, were to be handled so far as possible by the inspector or patrolman equipped with a light inspection car. In view of the increased length of the sections it was the plan to house the enlarged gangs in outfit cars which could be spotted at the town nearest the point at which the gang was working so as to reduce to a minimum the time lost in transporting the gangs to and from work.

Extent of Application

This plan was first placed in effect experimentally in 1932 on the Wichita Falls-Abilene line of the Wichita Valley (a branch line district which intersects the main line at Wichita Falls), where its application was attended with such success that subsequently it was introduced on all the other branch lines of the F.W. & D.C. These include the Stamford-Spur and the Wichita Falls-Waurika branches of the Wichita Valley, which are 82 miles and 38 miles long, respectively; the Ft. Worth & Denver Northern, which extends north from Childress on the main line to Pampa, 111 miles; and the Ft. Worth & Denver South Plains, which extends from Childress through Sterley to Dimmitt and from Lubbock through Sterley to Silverton, a total of 202 miles of line. The new system has also been placed in effect on a portion of the main line, namely, the Fourth district which embraces that part of the line between Amarillo and Texline on the Texas-New Mexico border, a distance of 117 miles.

As the organization on the Wichita Valley affords a typical illustration of the application of the new plan, the system as it has been applied to this line will be described in detail. This line involves a total of 270 miles of branches, all of which are located in the flat or gently rolling terrain characteristic of north central Texas. It is laid with 75-lb., 80-lb. and 85-lb. rail with some 52-lb. rail still remaining in service. Other features of the line include four-hole angle-bars, with some six-hole bars on the Spur branch, about 18 ties to the 33-ft. panel, and ballast consisting of pit-run gravel, locomotive cinders, caliche and native soil. The ties, which are largely treated southern pine with some gum, originally were not tie-plated; however, all ties that have been installed since 1928 are plated. Rail anti-creepers are applied in limited quantities.

Traffic conditions on the Wichita Valley vary from extremely light to medium. Between Wichita Falls and Stamford, 111 miles, which may be considered the main line of this branch line district, the train service comprises a motor car and a local freight each way daily, with an occasional cattle train. On the Spur branch a mixed train operates each way daily, while on the Waurika line the service offered is confined to a tri-weekly freight train.



Sketch Map of the Fort Worth & Denver City and Wichita Valley Lines

On the Wichita Valley

The attention of the railroad was first focused on the line between Wichita Falls and Abilene, 151 miles, which under the old system was divided into 16 sections, including a yard section at Wichita Falls and 15 road sections averaging

about 10 miles in length. At that time the number of laborers averaged two per section.

In applying the new maintenance organization, the railroad divided the road mileage into four sections having an average length of 37½ miles. After allowing for the wages of four patrolmen, the savings effected through the elimination of 11 foremen were equivalent to the wages of 20 track laborers. When added to the 30 laborers already in service this gave a force of 50 men available for the four gangs. As this figure was considered somewhat large, a force was established consisting of an average of eight laborers per gang, which was subsequently further reduced to an average of about five men per gang during the working season and even to less during the winter months.

The Section Gangs Are Free to Spend Practically All Their Time Reconditioning the Track Out of Face

In a similar manner the number of sections on the Spur branch was reduced from 9 to 3, one of which is 41 miles long and the other two each slightly more than 20 miles in length. On the Waurika line the number of sections was reduced from three to one.

The section gangs do all necessary maintenance work on their respective territories except the out-of-face tightening of bolts, which is done periodically by a two-man gang with a mechanical bolt tightener. In its routine out-of-face work the section gang gives the track a light lift, renews the ties that have been marked in advance, oils the joints and gives the ballast a rough dressing. Doing this work, each gang is expected to get over 20 to 25 per cent of its territory each year and, thus, over its entire territory about once every four years. Experience has shown that a five-man gang can complete about 600 ft. of track in an eight-hour day: during July the gangs on the Wichita Valley covered from 1¼ to 1½ miles of track in addition to accomplishing such other tasks as the dismantling of a spur track, the repairing of damage caused by washouts and the necessary spot work.

In order to insure that the work of the gangs is conducted in the most efficient and economical manner, their activities are supervised closely by the roadmaster and all their work, except that of an emergency nature, is programmed in advance by this officer in collaboration with the superintendent. In the programming the routine out-of-face work can be mapped out in advance for practically the entire season, but any spot work that the patrolman is unable to handle, such as the renewal of broken ties and the correction of bad conditions in soft cuts and defects in the alinement, must be planned in a somewhat different manner. In programming such work, the roadmaster, during his frequent visits over the line, makes notes of the defects that he finds and when sufficient work has accumulated in any locality to occupy the attention of the section gang for a day or more, the gang is dispatched to that point with instructions as to, the work to be done.

The outfits provided for each of the enlarged gangs include a combination foreman's and kitchen car, a bunk car and a tool and supply car. In some instances meals for the men have been provided by a commissary company, although as a rule the laborers do their own cooking.

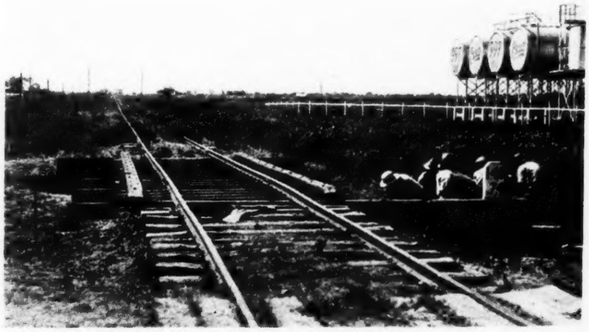
As the success of the new system of track maintenance depends to a considerable extent on the alertness and capabilities of the patrolman, this individual plays an important part in the new setup. Since it was possible, however, to choose all the patrolmen from among the displaced foremen, no difficulty was encountered in obtaining men with the necessary qualifications.

Patrolman's Duties

Each patrolman is provided with a light inspection car and a kit of tools, including a claw bar, a lining bar, a track wrench, a spike maul, a level board and a track gauge. He is required to make a round-trip daily over his section inspecting the track, switches, bridges, culverts, etc., correcting any defects and doing any spot work that he is able to handle alone. In addition, he is required to make a daily report of his findings to the foreman. Occasionally the patrolman is accompanied by a member of the regular section crew who assists him in doing work that cannot readily be handled by one man.

Thus, by delegating as much spot and miscellaneous work as possible to the patrolmen, the section gangs are free to continue their routine out-of-face operations with a minimum of interruption. It is felt, moreover, that the arrangement affords a type of inspection and patrol that is highly superior to that ordinarily provided on branch lines.

An Enlarged Gang Straightening a Bridge That Was Knocked Out of Line by a Highway Truck



The results obtained as a consequence of the application of the system to the Wichita Falls-Abilene line were considered highly satisfactory by the management. In less than three years light surfacing and tie-renewal work was completed on more than 60 per cent of the entire mileage, and, in spite of the further

(Continued on page 242)

Simplifying Curve Calculations

By R. W. WILLIS
Division Engineer, Chicago, Burlington & Quincy, Galesburg, Ill.

WITH train speeds being increased on every hand, the subject of curve alinement has assumed a new importance. Not only are the railroads finding it desirable to reline many curves for the purpose of applying easement curves where heretofore they have not been considered necessary, but in numerous instances they are relining curves with the object of incorporating more recent standards pertaining to curvature, superelevation and easements.

With the thought that they may be helpful to those who are assigned to or have supervision over this curve re-alinement work, I am offering below two methods pertaining to different phases of this work, which I have used with success. One of these is a method for determining the approximate new radius of a curve to which easements are being applied for the first time, while the other comprises what I believe to be one of the most simple and rapid methods for running long curves by the transit method.

When easements are applied to a curve, the tangent lines for the curve are offset from the track tangents a distance which varies with the length and type of easement used and the degree of the curve. For this reason, if the curve has not previously been spiraled and if the degree of curvature is not changed when the easements are applied, it will be necessary to line the curve in throughout its length, thus shortening the curve and usually making it necessary to cut several rails when lining the track over. In order to avoid the additional expense of this work a degree of curvature should be chosen that will cause the track to be lined out in the center of the curve an amount sufficient to balance the necessary inward throws at the ends.

The amount that the external distance (distance between the center point on the curve and the point of intersection of tangents) should be shortened to line the track out at the center of the curve varies with the angle of intersection of the tangents and the distance that the tangent lines of the new curve are to be offset from those of the present curve. It is usually considered as being equal to one-half the tangent offset. If this figure is accepted, the radius for a curve that will entail the desired throw at the center may be readily calculated from the following formula:

$$R = R_1 - \frac{1\tfrac{1}{2}O}{\text{Exsecant } \frac{I}{2}} \qquad (1)$$

Where R = radius of revised curve
R_1 = radius of present curve
O = tangent offset
I = angle of intersection between tangents

If I is a large angle the following formula should be used:

$$R = R_1 - \frac{\frac{O}{2} - \frac{O}{\text{Sine } \tfrac{1}{2} \text{ complement of I}}}{\text{Exsecant } \frac{I}{2}} \qquad (2)$$

The radius of the existing curve and the angle of intersection can usually be obtained from the alinement plats, while the tangent offset can be determined from available data in accordance with the practice of the individual railroad. The radius thus obtained should be used as a trial figure in running in the curve. If it does not appear to be satisfactory, it can be revised in accordance with the procedure outlined below.

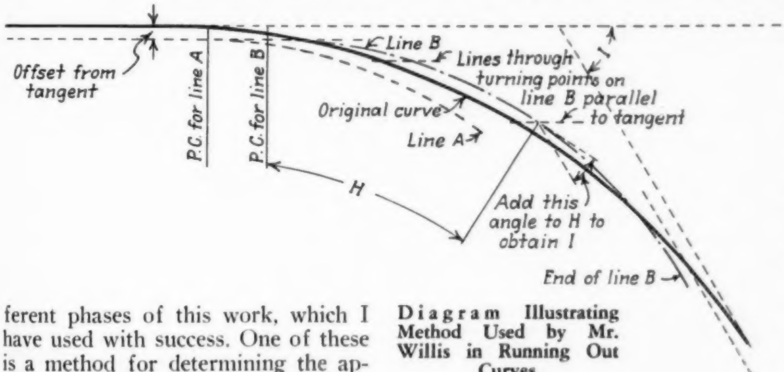


Diagram Illustrating Method Used by Mr. Willis in Running Out Curves

The following method for relining curves is especially adaptable to use where there are no known points on the curve and it is being fitted with easement curves for the first time, in which case a trial radius obtained by the foregoing method is used. The method may also be found useful in relining curves that are already supplied with easements. It is particularly useful when used in connection with long curves where other methods of fitting a curve to the track are likely to involve tedious calculations.

The First Step

The first step is to establish the offset tangents for the revised curve. Next it is necessary to locate the point of curve (P.C.) on one of the offset tangents. This is done by selecting a trial P.C. and running out a portion of the new curve, this curve being designated as Line A on the accompanying diagram. A convenient point is then selected on this line, from which the radial distance to the center of the track is measured. Another trial P.C. is then located on the offset tangent by moving the first trial P.C. forward or backward in accordance with the following formula:

$$d = \frac{r}{\text{Sine } i} \qquad (3)$$

Where d = the distance the trial P.C. is moved
r = the radial distance between a point on the trial curve and the center line of the track
i = the central angle to the point where the radial distance is measured

If the trial curve falls outside the existing curve, the point of curve should be moved backward along the tangent and if it falls inside the track

the point of curve should be moved forward. With the point of curve thus established, a second line, indicated on the diagram by Line B, is run out with the transit, using the same degree of curve as for Line A and setting turning points at intervals of about 500 ft. Line B should fall within a few feet of the center of the track; if it is apparent that this line is going to run off the embankment the operation should be repeated. Assuming, however, that Line B falls within a reasonable distance of the center of the track, lines parallel to the P.C. tangent are established at the various turning points by setting points on the ties. As explained later these parallel lines are to be used in establishing the final points on the curve in its correct position.

At some turning point near the end of Line B the central angle (I) should be checked or established by the following method: A line parallel to the tangent at the point-of-tangent (P.T.) end of the curve is established through the point in question and the angle between this line and a line tangent to the curve at the same point (see diagram) is measured. The total central angle for the curve is then obtained by adding the value thus obtained to the central angle up to the point at which the angle measurement is made. If the figure for the total central angle that is obtained in this manner does not check with that shown on the alinement plat, the length of the curve (Line B) should be recalculated on the basis of the newer information.

Final Adjustment

In the next step the end of Line B is established and the radial distance between this point and the P.T. tangent is measured. The amount that the P.C. of Line B should be moved in order to establish its final position is then obtained by formula No. 3, substituting the figure representing the distance between the end of Line B and the tangent for (r) and the total central angle for (i). All turning points on Line B are then moved this same distance along the lines that were previously established parallel to the P.C. tangent.

It is possible that Line B in its final position will be satisfactory and in this event additional points should be set at the proper intervals and final center stakes driven. However, if it should call for excessive or unbalanced throws a different degree of curvature must be chosen. This is done by determining how much the external distance of the desired curve would be shorter or longer than the external distance for Line B. Using this figure the amount that the radius of Line B must be changed to give the desired radius is obtained by means of the formula:

$$a = \frac{E}{\text{Exsecant } \frac{I}{2}} \qquad \text{(4)}$$

Where a = the amount that must be added to or substracted from the radius of Line B
E = the difference between the external distances of Line B and the desired curve
I = the central angle

If the external distance for the desired curve is shorter than that for Line B the figure obtained by this formula should be subtracted from the radius of Line B in order to obtain the desired radius; if the external distance is to be lengthened the radius for Line B should be increased by the distance (a).

It will now be necessary to move the P.C. and P.T. for Line B either forward or backward in accordance with the following formula:

$$b = a \text{ Tangent } \frac{I}{2} \qquad \text{(5)}$$

Where b = the distance the P.C. and the P.T. must be moved
a = the amount that the radius of Line B will be changed as obtained by formula No. 4
I = the central angle

If the radius of the new curve is to be longer than that for Line B, the P.C. and P.T. will each be moved backward away from the point of intersection; otherwise they will be moved toward the point of intersection.

The next and last step is to set the final center stakes for the new curve. In doing this work advantageous use can be made of the turning points that were previously established for Line B in its final position. The distance to the final curve from any turning point (P) on Line B may be obtained by computations based on the following formula:

$$b = E - (R_1 \text{ Vers. } \theta - R_2 \text{ Vers. } \phi) \qquad \text{(6)}$$

Where b = the distance to be measured from (P) on Line B along a line parallel to the external to locate a point on final curve
E = the difference between the external distances of Line B and the final curve
R_1 = the radius of Line B
θ = the central angle between the center of the curve and (P) on Line B
R_2 = the radius of the final curve
ϕ = the central angle between the center of the curve and the point on the final curve where it is intersected by a line through (P) parallel to a radial line (external) through the center of the curve.

The formula given is for use where the final curve falls inside Line B. If the final curve lies outside Line B that part of formula No. 6 in parentheses should read (R_2 Vers. $\phi - R_1$ Vers. θ) While this formula is not exact, any errors that may be incurred in its use are so small that they may be ignored. However, since it involves somewhat lengthy computations, it may be found more desirable to run in the entire curve without attempting to establish turning points from corresponding points on Line B.

Longer Sections

(Continued from page 240)

force reductions that were made, it is felt that the physical condition of the property has been substantially improved. Meanwhile, the total labor expenditures under the new system are currently less than 50 per cent of what they were when the old organization was in effect. In view of these results the plan was subsequently applied to all branch lines and the one main-line district as previously described.

Owing to unfavorable conditions encountered on the Fourth district of the main line the maximum benefits of the plan have not yet been obtained on this district. During the spring and early summer of 1935 the section gangs in this territory were required to spend so much of their time in repairing the damage wrought, first by sand storms and then by floods, that little progress was made in the conduct of out-of-face surfacing and tie renewal work. However, as the operations of any type of organization would have been adversely effected under similar circumstances, the management is convinced that under normal conditions the plan will produce results on the main line comparable to those obtained on branch lines.

The type of organization described above was conceived by, and installed under the direct supervision of J. D. Farrington, general manager of the F.W. & D.C.

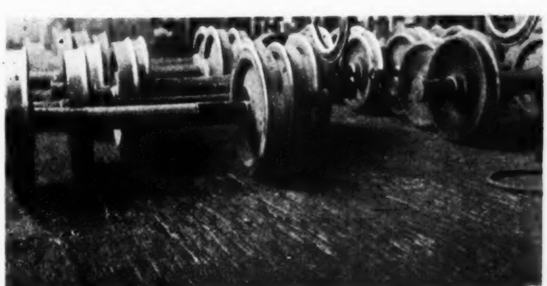
Scrap-Rail Flooring Mats Withstand Severe Abuse

TO THE many effective uses to which scrap rails have been put in recent years in the maintenance or strengthening of specific details of the fixed properties of the railways, the Erie has added that of flooring at local spots in locomotive shops subject to unusually severe wear or abuse. In this, lengths of rails, laid base up and parallel to form a mat, are grouted into the floor. Thus laid, the rails take the wear and abuse, while the grout filler provides the uniform support beneath and around the rails necessary to prevent possible breakage of the base flanges.

Sections of this rail mat flooring have been in service for more than a year at several points in the locomotive shop of the road at Hornell, N.Y., and have stood up satisfactorily. In fact, they have proved so much more satisfactory than other types of flooring in these particular locations that those in direct charge of maintaining the flooring within the shop are requesting a number of additional installations.

Flooring Subject to Severe Use

The situation which brought about the use of the scrap-rail mats for flooring was the impossibility of maintaining several other types of flooring in the wheel department, and also directly in front of certain heavy-duty lathes in the machine shop. In the wheel runways and storage areas of the wheel department, the wheel flanges played havoc with the flooring, and about certain of the machines in the machine shop, the handling of heavy castings and locomotive driving wheels before and after being worked caused the floor material to be pounded down or battered to pieces.



Wheel Flanges and Heavy Castings Cut Deep Into the Old Mastic Flooring Material.

The eight-inch concrete floor has proved generally satisfactory throughout the shop except at these points of special abuse. About five years ago, in an attempt to solve the flooring problem in the shop, the concrete floor was resurfaced with asphalt mastic, a hard mixture being employed in an attempt to meet the exacting conditions of wear and abuse. This was not without some success, but eventually deep holes were pounded out directly in front of machines and where wheels were stored or moved about, the mastic became badly cut up by the flanges. Patching remedied the situation for a time, but, at best, was only temporary.

Cutting Away a Section of the Old Broken-Down Mastic and Concrete Floor to House One of the Scrap-Rail Mats.

In the scrap-rail type of floor which has been installed, the rails are made to form a mat, which is set into the floor with its top surface flush with the surrounding floor level. In the formation of the mats, the rails are lined up parallel with each other, base up, and with adjacent flanges about one-half inch apart. In this position, they are bolted together by ¾-in. tie rods at intervals of about eight feet, the rods extending through holes drilled through the webs. Sections of one-inch pipe of proper length were slipped over the rods between rails to act as spacers, so that when the tie rod nuts are turned up, the rails are held rigidly in the mat formation.

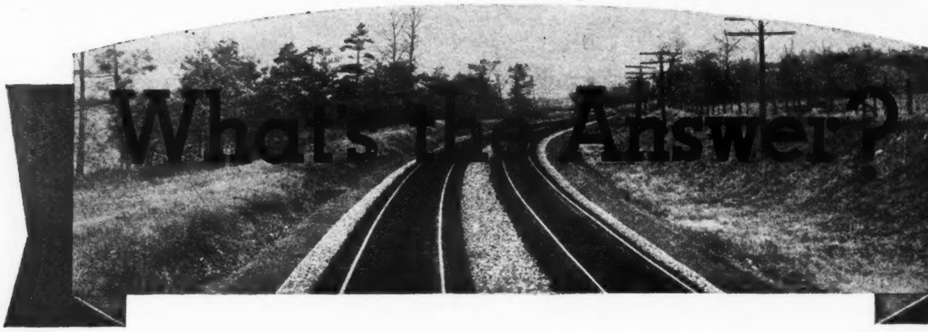
When thus assembled in its final location in the housing cut in the old floor, the mat is leveled up by wedging, if necessary, and then cement grout, consisting of one part cement and four parts sand, is poured between and about the rails. While the grout is intended primarily as a filler, it insures a level uniform bearing for the mat, and also provides a support beneath the rail base flanges to resist batter from above.

Paving Breakers Used

In the installations which have been made at Hornell, paving breakers, operated by air from permanent lines in the shop, have been used to prepare the beds for the mats, and air drills have been used to drill the rail webs for the tie rods. The largest mats have been 16 ft. long and 10 rails wide. These have been laid in the wheel storage area. Smaller mats, generally 10 ft. long, have been installed in front of certain machines.

One of the Sections of Scrap-Rail Flooring Installed in the Wheel Department of the Locomotive Shop at Hornell, N. Y.

While the installation of the mats is relatively simple and, at most, interferes temporarily with the normal shop use of only a small section of the floor at a time, the installations at Hornell were made on days or during periods when those parts of the shop affected were shut down, thereby avoiding all interference with shop operations. The work was carried out by the division bridge and building forces under the immediate direction of R. F. Pierce, master carpenter, and under the general supervision of B. Blowers, division engineer at Hornell at the time, but now located at Jersey City, N. J.



How Often to Inspect Rail

How frequently and in how much detail should rail in main tracks be inspected for evidence of approaching failure? Why? Who should make this inspection?

No Single Rule

By C. W. Baldridge
Assistant Engineer, Atchison, Topeka & Santa Fe, Chicago

Like most questions pertaining to track maintenance, no single rule can be applied to all cases of rail inspection for the reason that conditions vary widely even on different sections of a road and sometimes more widely between roads. Where rail from a single mill or of a given year's rolling is known to be afflicted with transverse fissures, inspection should be made semi-annually with a detector car. Rails which are reasonably free from this defect, compound fractures and head-checks (detail fractures), rarely need to be tested by the detector car oftener than once a year, and sometimes even less frequently.

Rails on sharp curves which are also on heavy grades, wear more rapidly and fail sooner than those where the conditions are less severe. In such locations the section foreman should make a thorough inspection of both the face and gage side of the head at least once a month for head checks, and also use a mirror to examine the underside of the head for fillet cracks. The roadmaster should join the foreman in this inspection from two to four times a year. Elsewhere, detailed inspections are usually required less frequently. This will depend in large measure, however, on a variety of conditions, such as train speeds, density and character of traffic, and whether the track is close to water or near the edge of a precipice.

When passing over any track, a roadmaster should keep close watch of the top of the rail, looking for flat spots and other indications of defects. A flat spot in the running surface indicates that a vertical or a horizontal-split head is developing and that the rail should be removed. These spots are discerned most easily by riding at a moderate speed, preferably on a slightly cloudy day, and watching the surface of the rail head from 30 to 60 ft. in advance. Such an inspection requires that undivided attention be given to the rail, for which reason the man making the inspection should not attempt to operate the car. Furthermore, an inspector can attend to but one rail at a time.

Rails having well developed head checks are quite likely to break soon and should, therefore, be removed from the track as soon as discovered. Rails having flat spots (not to be confused with driver burns) should be removed at once and any further service they may have can be utilized by placing them in unimportant sidings or industrial tracks where the movements are slow and infrequent.

Fillet cracks always occur along the top of the web at its junction with the head and are, therefore, parallel to the rail head. They develop very slowly, except where the rail is buried, as in a road crossing or through paved platforms. So far, no rails having fillet cracks have been known to break until after the crack has become visible on both sides of the web. Inspections of fillet-cracked rails should be repeated at six-month intervals until they become of sufficient size to make more frequent examinations advisable. Such rails should be removed from the track as soon as the crack can be distinguished on both sides of the web, even though it is little more than visible on one side.

The frequency with which rail should be inspected for all types of defects will, of necessity, depend on the density of traffic, the weight of

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in June

1. *Is it worth while to paint the adzed surfaces of treated ties with hot creosote? What are the advantages? What practical method can a gang employ to heat the creosote?*
2. *When installing deeper ties on open-deck bridges, what procedure should be followed? What precautions should be observed with respect to the passage of trains?*
3. *Can a rail be lined more easily when it is vertical or when canted? Why? Does the amount of cant make any difference?*
4. *What causes putty to crack and shake out? How can this be prevented?*
5. *When reballasting, under what conditions should track be given a high lift? A light lift? Why?*
6. *How should one proceed to clean out wayside storage tanks? How should the mud or sludge be disposed of?*
7. *What measures are necessary to insure the maintenance of uniform elevation on curves? What is the importance of each?*
8. *When an old stone pier or abutment begins to fail through breakage of the individual stones, what can be done to arrest the progress of the disintegration and to repair the damage?*

the equipment in use, train speeds and other factors, some of which may be local. While some of these inspections can and should be made by the section foremen, the eventual responsibility for all inspections to determining the probability of approaching failure rests upon the roadmaster or supervisor.

Foreman Should Inspect

By Henry Becker
Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

It is my belief that rail should be inspected in detail not less frequently than once a month. While certain defects, such as developing split heads, can be detected readily from a motor car, others, moon-shaped breaks, for example, are likely to be overlooked entirely. To only a slightly less extent this is also true of split ends. Furthermore, no one has yet discovered a fillet crack from a motor car.

For these reasons, I believe that the best results will be obtained when the foreman makes this inspection on foot, taking one rail in each direction and giving it his undivided attention. Base fractures are particularly dangerous. They may occur in considerable number during severe cold weather, but it is difficult to spot them from a motor car unless one rides directly over the rail at slow speed.

Two Purposes

By I. H. Schram
Engineer Maintenance of Way, Erie New York

In general, rail is inspected for two purposes: (1) To determine its general condition in connection with programs for renewal or reconditioning; and (2) to find whether individual rails are beginning to show signs of approaching failure. To some extent, these two types of inspection overlap, although both the method of inspection and the records are specialized for each. Usually, the data developed in investigations of rail in connection with renewal schedules, even though the rail may not be renewed immediately, are valuable, particularly on territory having many or sharp curves, because worn rail is quite susceptible to some types of failure and requires intensive checking. Where failures occur frequently in certain lots of rail, the records of these failures are also of value in determining the desirability of renewal.

On not a few roads, the practice of trackwalking has been discontinued, and routine rail inspection is now in the hands of section foremen, signal maintainers and supervisors. As a section foreman is most directly interested in the conditions on his section, he is the most logical person to make the inspection, and he can normally cover his territory often enough to insure detailed inspection, moving slowly enough on a motor car to observe the rails, stopping when necessary to examine them more closely. While it may be said that this will interfere with work, section programs, such as tie renewals, bolt tightening, drainage, etc., can be broken up over a section so that in ordinary movements to and from the work the rail can be inspected two or three times a week as necessary.

In automatic-signal territory, signal maintainers travel over their sections on motor cars and they can be trained to inspect rail at this time. In view of the importance of rail and its connection with signal performance, they are interested in its condition and in numerous instances they have developed into valuable and expert rail inspectors. They save many signal stops by finding defective rails before they have broken.

Track supervisors should inspect their main tracks from a motor car at least once a week, and many do this oftener. This is the best and most intelligent inspection of rails, as well as of other track details, and results in the greatest number of rails being properly cared for. For this reason, its importance cannot be emphasized too strongly. The supervisor's inspection also insures the immediate removal of rails that have external indication of defects. In recent years fissure-detector cars have been perfected and the results of their operation justify their frequent use, both as a safety measure and for financial reasons, since they prevent the unnecessary removal of rails in suspicious heats. On most roads, it has become standard practice to operate them at least once a year.

Welding Corroded Rivet Heads

Is it practical to build up corroded rivet heads by welding, or should the rivets be replaced? Why?

May Have Possibilities

By General Bridge Inspector

This practice is of too recent origin for one to say dogmatically that it is good or bad. In fact, the whole art of structural welding is so new that we have not yet progressed beyond the experimental stage and may be, therefore, ignorant of some of the essential features which require consideration. On the other hand, by drawing on our previous experience in structural design, erection and maintenance and with welding in other fields, I think we are warranted in making certain assumptions with respect to structural welding and then by proceeding cautiously to verify or prove them to be wrong.

Building up corroded rivet heads is one phase of this art which is only in its beginning and should, therefore, be approached with the proper degree of caution. We have tried it out in a small way as an experiment and have developed certain facts which may be mentioned. In the first place, every rivet should be tested for tightness and head bearing. No loose rivets or rivets that do not have a solid head bearing should be built up in this manner.

As might be expected, gas welding is not adapted for this work because too much heat is transmitted to the metal. So far as we have observed, however, we do not have this trouble with the electric arc, probably because the operation can be completed in so short a time. It is important that the metal be absolutely clean and bright to insure the proper bond. In addition, a narrow band of the plate encircling the rivet head should also be cleaned, because it is almost impossible to add the necessary metal without enlarging the diameter of the head slightly at its contact with the plate. The welding rod should be a low-carbon steel approximating that in the rivet head, and ample metal should be applied to insure a full section for the head. It is better to build the head up too much than to skimp it, and even with experienced welders we have found that there is a tendency to quit before the original amount of metal has been added.

We have also found it desirable to paint the welds with red lead as soon as they cool, for the added metal seems to gather a film of rust much sooner than the original rivet metal does normally. We felt some concern at first about the effect of heating the head of the rivet, fearing that expansion might create an unsatisfactory condition or that the head

might be made brittle. So far, we have failed to find any ill effects, as the heat apparently does not penetrate deeply and is conducted away quickly so that no such damage results.

Should Be Cautious

By G. A. Haggander
Bridge Engineer, Chicago, Burlington & Quincy, Chicago

Up to the present it has been our general practice to replace rivets when the heads become badly corroded. In a few cases we have built up the heads by welding, and I believe that, in general, it will be cheaper to build up corroded rivet heads than to replace the rivets. To do this requires less equipment and men and should give fairly satisfactory results. On the other hand, there are several objections to the practice. One is that metal placed by welding is usually less resistant to corrosion than ordinary rivet steel. Furthermore, a new rivet grips the metal because it shrinks as it cools, thus causing friction between the various members of the assembly. Building up the head by welding does not have this effect, but on the contrary, the heating which is inherent in the welding may loosen the rivet to some extent. However, adding metal by welding will arrest further loss of metal from corrosion and will strengthen the rivet head. I cannot see, therefore, that there will be any serious objection to making repairs in this manner in most cases.

When to Ship Crossties

Should the entire allotment of ties be shipped to a section before the renewal season opens, or should they be shipped as needed? Why?

Use Old Ties First

By A. W. Wehner
Roadmaster, Southern Pacific
Lake Charles, La.

Whether the allotment should be shipped in advance depends on several factors and particularly on the operating conditions of the district. If local freight service is available for unloading and the renewals are being made by the regular section forces in accordance with a predetermined schedule, the ties should be shipped as needed. This will insure a more timely distribution, assuring that the oldest ties will be used first, and it will also tend to eliminate the worst tie or track conditions first. Of prime importance, it will lessen the incentive for removing questionable ties, that is, ties that have not actually reached the end of their service life, which is done so often when a large supply of ties is on hand. It will reduce the amount of handling and, therefore, the opportunities for personal injuries, while the foreman can keep a closer check against theft if he does not have too many ties on hand.

Where the entire allotment is shipped in advance, the ties must be either piled and redistributed later or distributed over the entire section where they will be in the way of track mowers, discers, weed burners and drainage operations. In many instances, they will create hazards to trainmen. Again, if circumstances arise which disturb the tie-renewal program, extending it into the later months of the year, considerable additional labor will be required to protect the ties against grass fires.

Not Too Far in Advance

By J. E. Johnson
Roadmaster, Southern Pacific
Douglas, Ariz.

My experience is that the full allotment of ties should not be shipped in advance of the tie renewal season, and that prior to the opening of this season careful consideration should be given to the method to be followed in making the distribution to the small section gangs which now comprise our forces. However, where heavy renewals are necessary and are to be made with extra gangs, it may be desirable to ship the entire allotment before the gangs start their work.

The reasons for this are that if all of the ties must be shipped in advance of renewals, a heavy burden will be placed on the treating plant and some, perhaps all, will be sent out without the proper period of seasoning. Ties sent fresh from the treating plant lose some of their creosote from weathering, particularly in this section of the country where we have much sunshine and hot weather. It has been noticed that a large amount, sometimes estimated to be as much as 30 per cent, of the creosote soaks into the ground before the ties are installed in the track. If the ties are inserted while the creosote is still fresh, being embedded in the ballast, they are cooler and out of the direct sunlight, for which reason they do not check and their life is prolonged. Again, we lose some ties in floods and from burning when they are distributed too far in advance.

Ship As Needed

By T. E. McMannis
Supervisor of Track, Central of New Jersey, Somerville, N. J.

As a rule, it is better to ship ties as they are needed rather than to send out the entire allotment prior to the opening of the renewal season. It is recognized that different roads have different organizations and policies and employ different methods in making tie distributions. Yet, the foregoing rule still applies, whether the tie program is scheduled for completion in a few weeks or whether it is to continue from early spring until late in the fall. It does not matter whether the distribution is to be made by work train, spotting the ties directly at the point of use or unloading for piling until needed, or whether they are unloaded at stations for later distribution by motor cars and trucks. It is considered that ties are being shipped as needed, even though the entire allotment may be shipped to certain sections which have forces of sufficient magnitude to make their renewals in a few weeks and then proceed to the adjoining section, the ties for which would be shipped just before they are needed.

It is preferable to ship ties as needed, because this permits normal planning by all departments. The treating plant makes its deliveries without creating peak loads. The transportation and maintenance departments will not have an unusually large number of cars to handle at one time and relatively few revenue cars will be tied up in tie service. The ties will be spread over short stretches of the roadbed and will be cleaned up in short order. To carry out such a system, however, one must be assured that the ties will always be furnished in accordance with request. This is too narrow a margin to work on safely unless the supply is known to be dependable. Again, there is a disadvantage in handling the freshly treated ties, but accidents do not need to happen if the work is given careful supervision. The cost of this method is as low as others, since the expense of piling ties will not be incurred if

they are installed as soon as received.

To ship the entire allotment in advance places a tremendous burden on the treating plant and on the transportation and maintenance departments, while a large number of cars are taken out of revenue service for the period. Labor is diverted to unload and pile ties at a time when it is urgently needed on the track. Ties along the shoulder present an objectionable appearance and create a real hazard, particularly if the whole road is lined with them. While the old ties may be disposed of as they are removed, and the line of new ties will disappear gradually, yet a large number will be likely to be spread out for several months longer than they need be. The principal advantages of advance distribution are the certainty that the quota will be filled for renewal and the easier handling of the seasoned ties.

Repairing Brick Platforms

Where a brick platform is worn enough to interfere with the movement of trucks, can it be repaired without replacing the worn bricks? If so, how?

Turn the Bricks Over

By Frank R. Judd
Engineer of Buildings, Illinois Central, Chicago

Where a brick platform becomes worn enough to interfere with the handling of station trucks, it is usually an easy matter to repair it by taking up the bricks and relaying them with the worn side down. It should not be overlooked, however, that in many instances an uneven surface on a brick platform is due to settlement rather than to the wearing of the brick. Where this occurs, the proper action is to take up the brick, regrade the base and relay the brick.

Good results can also be obtained through the application of a resurfacing material, of which there are many on the market. In selecting such a material, consideration should be given to the type of traffic moving over the platform and the climatic conditions to which it is subjected. The material should be applied in accordance with the makers instructions.

Same As for Concrete

By E. R. Tattershall
Supervisor of Structures, New York Central, New York

I have had no occasion to make repairs to brick platforms of the type suggested in the question, but I have found it necessary to eliminate ruts which have developed in concrete floors as a result of the operation of steel-tired trucks over them. In making these repairs, I have made use of two types of material, both of which have proved satisfactory. The first is a material which is mixed with sand, cement and water for light trucking, ¼-in. stone being added for heavy trucking. This material is placed and finished with a trowel the same as any other finished concrete wearing surface. The second is also a proprietary material, asphaltic in character, which is mixed with cement, sand and gravel to form an asphalt mastic. I can see no reason why these same materials, or others of similar character, of which there are a number on the market, cannot be applied with equal success to a brick platform. The important point is to have the surface to be repaired thoroughly clean before application of the new material is undertaken.

Mentions Two Methods

By E. H. Roth
Assistant Engineer, Norfolk & Western, Bluefield, W. Va.

Brick platforms that become worn enough to interfere with the handling of trucks can be repaired economically without disturbing the worn bricks by either of two methods: (1) By the application of cement mortars, some of which are patented products; and (2) by the application of asphaltic materials. Either of these methods is both practicable and economical. I recommend the first class of materials where the trucks in service have rubber tires, and the second class where steel-tired trucks are used. Both classes of material can be applied in almost any desired thickness to bring the surface to or above its original level. In either case, however, the worn surface must be cleaned thoroughly and the application must be made in accordance with the manufacturer's instructions if best results are to be expected.

What Type and Size of Well?

What considerations determine the type and size of wells required to obtain water from underground sources?

Examine Existing Wells

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Unless one is prospecting in an unknown and undeveloped territory, some information as to the type and size of the well required can usually be obtained from existing wells in the near vicinity. Obviously, the first consideration is the amount and quality of the water required. If it is for locomotive feed water, quality will be an important consideration, and an analysis of existing supplies will be desirable. In some cases, water from comparatively shallow wells will be the best, while that from deep sources may be so heavily laden with mineral salts as to be totally unfit for use in its natural state and it may not even be susceptible of treatment at reasonable expense. An example is that of a study made recently in which glacial drift consisting of gravel, sand and till to a depth of about 200 ft., overlies a bed of clay about 800 ft. thick, below which is sandstone, bearing water under sufficient pressure to cause an artesian flow above the ground surface. The water in the glacial drift is mostly from surface sources and, having been filtered by nature, is usually of fair quality for boiler use. That from the sandstone is very high in minerals, the common salt content alone being about 17 lb. per thousand gallons. In other cases, exactly the reverse occurs, because the upper-soil strata are heavily laden with mineral salts which are dissolved out by the surface seepage.

For these reasons, the quality of the water may determine largely the type of well. If it is to be of the open surface type, the size will depend on the demand and the rate of infiltration through the water-bearing medium. If it is in coarse water-bearing gravel near the surface, the diameter may be

only sufficient for the placing of the centrifugal or reciprocating pump in the pit. If the water stands at a lower level, requiring a turbine pump, the diameter may vary from 6 to 24 in., depending on the size of the turbine needed to satisfy the demand. If the water is in a stratum of fine sand having a low percolation rate, the well diameter should be great enough so that when the pump is operated at its maximum rate, the demand will not exceed the natural flow, and thus by straining the water-bearing medium tend to disturb the fine sand.

Where deeper sources must be developed to obtain suitable water, the diameter of the well will depend on the static level of the water and the depth of the drawdown under the maximum rate of pumping. The diameter between the static and the drawdown levels must be large enough to accommodate the turbine or other type of deep-well pump required. Another consideration is the thickness and the inflow rate of the water-bearing stratum. If the flow is limited, a gravel-filled well of comparatively large diameter may be required, together with the use of a long screen or perforated casing. If the well penetrates into what seems to be an underground lake or a stream flowing through coarse gravel, the diameter may be the smallest that will fully accommodate the pumping equipment. In very deep wells from which the water is raised with air, the depth should be sufficient to give from 45 to 55 per cent of submergence at the maximum pumping rate. The diameter should ge great enough to allow ample space for the entering of the foot piece with eduction and air pipes of sizes which will preclude excessive friction.

There is sometimes a tendency to put down wells of such small diameter that it becomes difficult to place deep-well cylinders or turbines of proper size. It should be kept in mind that there is little difference in the labor cost for a well of, say, 2-in. larger size than that contemplated and the saving of extra expense for a larger casing may be more than offset by maintenance costs at a later date.

Depends on Many Factors

By R. C. Bardwell
Superintendent Water Supply, Chesapeake & Ohio, Richmond, Va.

In general, the considerations which determine the type and size of wells required to obtain water from underground sources will in themselves be influenced largely by the conditions peculiar to the locality. If reasonably definite information concerning the character of the underground formations and the quantity and quality of the water available, cannot be obtained from records on hand, it is advisable to drill test holes which will give an approximately accurate log of the strata to be encountered. If this is done by a properly qualified and experienced well driller, it is usually possible to obtain a reasonably good estimate of the water available and the type of installation which will give the most effective and reliable results.

The type and size of the well will depend on the formation, the water available and the consumption requirements. If the well will be in rock, the diameter should be great enough to accommodate the pumping equipment that is to be used. If only a moderate amount of water is required or is available, and the well is finished in a sand or gravel formation, a suitable well screen may permit its development. If, on the other hand, a larger quantity of water is required and the water-bearing strata are separated, it is usually desirable to install a well of the gravel-wall type, with careful development.

Well drilling is a special and fairly broad field of engineering endeavor. If the proposed installation is of considerable economic importance, it is usually advisable to obtain advice and recommendations from an experienced and dependable well engineer as to the potentialities of the location before determining the type and size of the wells to be installed.

Renewing Decks Under Traffic

How does one go about renewing the deck of a ballast-deck trestle under traffic?

Have Everything Ready

By J. M. Davis
Bridge and Building Foreman, Illinois Central, Freeport, Ill.

It is highly important to have everything ready before undertaking to renew a ballast deck. Any caps needing renewal should be replaced before starting to remove the ballast. After this, or in case no caps are to be renewed, the ballast should be shoveled out and blocking placed under the rails to permit the passage of trains. Next remove the old guard rails and floor planks. If the interval between trains is short, sufficient of the new floor planking should be slipped in place to carry traffic; otherwise, it should not be placed until the new stringers are in. If the time between trains is short, one-half of a panel can be renewed at a time, the planks being shifted back and forth as necessary.

In either event, however, it is better to renew the outside or jack stringers and fasten them securely before attempting to renew the intermediate ones, as this will provide means for insuring the stability of the deck, by nailing a few of the planks to them, during the passage of trains. The floor planks should be spaced and nailed as soon as the new stringers are secured. As the work progresses, the ballast guards should be placed and bolted, but except on long trestles, no ballast should be unloaded until the entire deck is in place.

A word of caution is necessary. The blocking should be so designed that the load will not be concentrated on one or two stringers in a panel or they may be broken. Likewise, too much ballast in one spot may create the same danger. Ballast should be unloaded from center-dump cars. In preparation for this, the blocking should be shifted out toward the ends of the ties as far as practicable and only the center of the track filled. The ballast should be tamped lightly and the blocking removed, after which the track can be filled and surfaced.

Requires Skill

By General Bridge Inspector

It has been my observation that in about seven cases out of ten, when the deck of a ballast-deck trestle needs renewal, the bents are so near the end of their service life that it is more economical to renew them at the same time than it will be to carry them for a few years and then assume the greater cost of replacing them under the relatively new deck, which obviously will receive a certain amount of damage during the operation and will thus have its service life shortened. It should not be overlooked in this connection that when a trestle of this type is opened up, it is almost invariably found to be in poorer condition than was indicated on the inspection reports. It should also be recognized

that the renewal of such a deck under traffic requires greater skill than an open deck.

It is assumed that no caps are to be renewed and that all material is on the ground and has been checked. Before the work is started, the timbers should be sorted and laid out in the order in which they are to be used, at some place where they will be readily available. The next thing is to get rid of the ballast. If it is gravel, it is usually best to discard it and apply new material at the close of the work. If stone, its condition and the cost of salvaging it may be the deciding factors. As the ballast is removed, the track must be supported at its original level. An excellent way to do this is to remove the outer lines of stringers and slip them under the ties, using shims as necessary to bring the ties to the proper elevation.

After the ballast is out of the way, the deck planks over the bents can be slid out and the drift bolts pulled from the stringers. As soon as the interval between trains will permit, the stringers under the track can be pulled out and the remainder of the deck planks taken up. The stringers are then ready for removal. This can be accomplished quickly by shifting them endwise far enough to drop one end. The new stringers should then be placed, preferably with a crane as this will save much time.

As soon as the new stringers are in place, several men should begin to bolt them—we do not drift them now—and the deck planking and ballast guards can be laid. It will then be necessary to replace the stringers under the track until the new ballast is dumped. Only enough ballast should be unloaded to support the track after the blocking is removed, after which the remainder can be placed.

If the trestle is short, say, of only a few spans, it may be desirable to withhold the ballast until the entire deck is in place. If it is longer, it may be desirable to carry out the work progressively.

Large or Small Gangs in Yards

What are the relative merits of one large gang or several smaller gangs in a large switching yard?

Limit Is 25 Men

By J. B. Kelly
General Roadmaster, Minneapolis, St. Paul & Sault Ste. Marie, Minneapolis, Minn.

Gangs containing up to 25 men are the most economical and satisfactory for handling maintenance in large yards, as well as for improvement work. This force may be handled by a general yard foreman with the aid of the required number of assistant foremen to permit breaking the larger gang in smaller units when this becomes desirable. The abandonment of switching leads and body tracks to permit working a large force is reduced to the minimum, which promotes valuable co-operation between the maintenance and operating departments, since few yards are constructed with provisions for abandoning any considerable amount of trackage to accommodate repair work. With such an organization, minimum crews can be assembled locally and kept on specific programs for a longer time to do the same work.

Where large gangs are employed delays are inevitable, while such an organization is usually more expensive, since it generally includes men who are not local residents and who must, therefore, be housed in outfit cars. The work of a large gang must, of necessity, be more of the out-of-face type rather than that of routine repairs. For this reason, it is likely that much material will be replaced with new, which should be fit for further service. On the other hand, the ideal force is one which permits the work to be outlined on a conservative basis, and the supervisory staff to exercise control to the point where the work will be done with a much closer margin. After all, the amount of money spent to accomplish the objective of keeping the yard safe and in satisfactory condition for operation, including the actual labor, the cost of taking tracks out of commission, the likelihood of discarding material prematurely and the cost of housing men, many of whom are irresponsible floaters, is the factor which usually will tip the scales in favor of the smaller gang.

Yard Work Is Special

By O. J. Smith
Rail Gang Foreman, Chicago and North Western, West Chicago, Ill.

Track work in large switching yards is a special form of maintenance, owing to the rapid wear of the track materials, especially on busy leads and on ladder tracks, to the large number of turnouts which must be given almost constant attention and to the difficulty of getting tracks released for the purpose of working on them. Ordinarily, a large yard is divided into a number of units, in each of which about the same amount of work is required. For this reason, it is advisable to place the entire yard in charge of a general foreman, and each of its units under an assistant foreman with as many men as the work in that unit demands.

While small emergency jobs which must have immediate attention may be expected to arise constantly, these can be provided for without disrupting the general program. A schedule of trackwork for the yard as a whole, covering the current month or, better yet, the season, should be prepared in advance by the roadmaster and the foreman, and a copy given to every assistant foreman. It seldom happens that this program can be carried out in its entirety, but it is a great help in co-ordinating the efforts of the several assistant foremen, since they will all be working toward a common objective. At the end of the season, more work will have been done and the yard as a whole will be in better shape than if there is no system and each assistant foreman is allowed to carry on his own work with no thought or care as to what the others may be doing. It will often happen that yard operations will not permit certain work to be done at the time it is scheduled, in which case the next one scheduled on the program can be started.

One of the advantages of this form of organization is that while each unit is self-contained and has assigned territory, all of the units can be combined into a large gang to do the larger job. If a track needs ties and surfacing, the entire force can be concentrated on it and the work completed in a short time when it will not interfere with the yard operation and the several units can return to their own sections of the yard without loss of time.

Wants Better Supervision

By Thor Monrad
Track Supervisor, Northern Pacific, Reed Point, Mont.

I am in favor of using smaller gangs in large yards for the reason that one large gang will most certainly work to less advantage. There are always so many places in a large switching yard that require attention at substantially the same time, each of which demands experienced super-

vision, while it seldom happens that more than a few men are needed to make the individual repairs, that it is difficult and sometimes impossible to provide the necessary supervision if a large gang is employed.

Furthermore, a large yard occupies a large area and is sometimes strung out for several miles. In this event, a considerable percentage of the time that might otherwise be applied constructively is lost in moving men from one place to another. On the other hand, if the forces are organized into a number of smaller units, each of these can be assigned to specific areas with which they shortly become intimately acquainted, there will be the minimum loss of time from moving about and every operation can be given close supervision.

Depends on Yard Layout

By Robert White
Grand Trunk Western, Pontiac, Mich.

In my experience in some of the largest yards in the country I have observed that every yard has special problems. For this reason, the relative merits of large and small gangs will depend in large measure on the yard layout, the character and amount of traffic passing through and the methods of operation. A large compact yard is better suited for a large gang, because less time will be lost in moving from one place to another; yet such an organization should be flexible enough to allow the detachment of small units from the main gang to care for the routine repairs which are always demanding attention. On the other hand, there are many yards, even some comparatively small ones, in which the individual units are so widely separated that it would be impracticable for a single gang to handle the yard as a whole. This also applies to certain yards I have in mind where there are many industry tracks leading to widely scattered industrial centers.

Unless it is possible to allot enough men to the individual gangs to make it possible for them to handle all of their work, it would be better to organize a large gang with one or more assistant foremen and send out small detachments to handle minor repairs. I have in mind the case of a yard of considerable size from which a number of branch lines radiate, which has four gangs, not one of which is able to handle all of its own work. If these gangs were combined, the one gang probably could do more work than the four are now able to do separately. Because of the varied conditions, every yard is a problem in itself and no fixed rule can be applied. For this reason, only those officers in responsible charge can work out the problems with respect to the type of organization best suited for the individual yards.

Fundamentals of a Rail Joint

What essential characteristics must a rail joint possess to minimize damage to the rail ends?

All Are Essential

By Engineer Maintenance of Way

First and most important, if a rail joint is to perform effectively the service for which it is intended, it must have a contour which will fit the rail. If it does not, no matter what other desirable features may be incorporated in the design, it will be a failure. Of equal importance, the fishing height should be slightly greater in the joint than in the rail. This is a matter that should never be overlooked or ignored. Its importance lies in the fact that as the bolts are tightened, a wedging effect is produced to give a better support to the rail, while it also provides for a certain amount of take-up as the fishing surfaces begin to wear.

Dr. Talbot's investigations have shown that as the section becomes more nearly balanced or symmetrical, the joint performs more satisfactorily. In other words, a symmetrical section eliminates the lateral distortion which takes place in a joint of unsymmetrical section when it is loaded and, therefore, much of the relative movement between the rail and the joint as it is loaded and unloaded by the successive wheels of a train. By reducing this movement, the wear between the fishing surfaces of the rail and the joint will be reduced.

To support the rail properly, the joint must have the maximum vertical strength compatible with proper economy of design. But it should not be forgotten that vertical strength depends in large measure on the accuracy with which the joint fits the rail. Lateral strength is also an essential characteristic of a rail joint, but this should not be carried to the point of complete rigidity, since a certain amount of flexibility is also necessary.

Must Be Balanced

By W. E. Gadd
The Rail Joint Company, New York

If rail joints are to function efficiently over an extended period of time, certain essential characteristics should be incorporated in their design. Among these, they should have vertical strength which is contingent on the accuracy with which they fit. They must also have lateral strength concurrent with flexibility. There should be a balance of physical properties. It is also especially important that sufficient provision shall be made for take-up, to insure that at all times there will be positive contact between the center of the joint and the rail ends. This latter feature is not always given adequate consideration.

They Must Fit

By William Michel
Chief Engineer, Engineering Advisory Committee, Chesapeake & Ohio, Cleveland, Ohio

This is a subject that has been uppermost in the minds of engineers for many years, particularly those who have been engaged in designing rail joints. Among the essential points to bear in mind when designing a rail joint are that it must fit the rail section accurately and that it should have as much strength, both laterally and vertically, as it is possible to secure, always keeping in mind that the section must be an economical one.

However, the design of the joint has little to do with the damage to the rail ends of the type commonly called end batter and chipping. It is my contention that too much gap between the rail ends is responsible for more damage to the rail ends than poorly designed joint bars. I believe that the expansion tables now being used leave too much opening and that they should be revised. I also believe that the amount of cross beveling, as this is now practiced after the heat treating of the rail ends, is about twice as much as it should be. This cross beveling should be only enough to insure taking care of the end flow which results from cold rolling.

When laying new rail, the joint bars should be well oiled and the tension on the track bolts should range between 7,000 and 10,000 lb. Furthermore, the tops of the rails should be ground off perfectly smooth at the ends to take care of the tolerance.

Loss and Damage Payments Increase

Freight loss and damage payments by Class I railroads during 1935 amounted to $17,946,049, as compared with $17,034,031 in 1934, an increase of $912,018, or 5.4 per cent, according to preliminary figures compiled by the Freight Claim division of the Association of American Railroads.

Elevator Association Favors Truck Regulation

A resolution approving the principles embodied in proposed legislation governing trucks and pledging its support to the program was adopted unanimously at the recent annual convention of the Farmers Elevator Association of Minnesota. In its resolution the association went on record as approving legislation that will prohibit the use of the public highways for the transportation of abnormally heavy loads; require the large trucks employed in long distance transportation to pay for their use of the public highways on a basis that is approximately proportionate to the taxes imposed on other classes of motor vehicles; require these trucks to pay actual taxes for the support of state and local governments comparable to those levied against the railroads; regulate all trucks employed in peddling, except those owned by farmers; and place the handling of grain by truck for compensation under the same regulations with respect to inspection, grading, weighing, etc., as when the grain is handled by railroads. The resolution also expressed opposition to any legislation that will add to the costs of the railroads, impair their efficiency or tend to increase railroad rates.

Rules for Paying Railroad Payroll Tax

Regulations under which the railroads and their employees will be required to pay the payroll tax enacted as a companion measure to the railroad retirement act, were issued on March 17 by the Bureau of Internal Revenue. The taxes apply only to wages paid and received during the period from March 2, 1936, to February 28, 1937, for services of employees and of employees' representatives. In general, according to the regulations, any remuneration for services as an employee of a carrier is taxable under the act, whether received in money or in other remuneration. Excluded, however, is any sum in excess of $300 paid by a carrier to an employee for services performed in any calendar month. Each employee is to be taxed 3½ per cent of his wages while each railroad is to be taxed an equivalent percentage of the sum of the wages it pays to its employees.

The act provides that each carrier shall withhold the tax on employees at the time the carrier makes wage payments. While not mandatory, employees are advised to keep permanent accurate records showing the name of each carrier for which he performs service as an employee, the duration of employment by each, the amount of each remuneration payment and date of its receipt, and the amount of employees' tax deducted from each payment.

Rail Orders

Several substantial rail orders were placed during the past month. The Chicago, Milwaukee, St. Paul & Pacific ordered 21,000 tons of rails from the Carnegie-Illinois Steel Company and 7,000 tons from the Inland Steel Company, while the Chesapeake & Ohio ordered 12,000 tons from the Carnegie-Illinois Steel Company, 6,000 tons from the Inland Steel Company and 2,000 tons from the Bethlehem Steel Company. The New York, Chicago & St. Louis has ordered a total of 6,000 tons of rails from various companies, while the Norfolk & Western is inquiring for 20,000 tons of 131-lb. rail.

Orders Lower Fares in East

The Interstate Commerce Commission has issued a report and order in its general passenger fare investigation prescribing a reasonable maximum future fare basis of 2 cents a mile one-way in coaches and 3 cents a mile in Pullmans, effective on June 1. As lower fares have already been placed in effect experimentally on the Western and Southern roads, this decision applies particularly to the Eastern roads which have never abandoned the regular basic fare of 3.6 cents a mile, except on special occasions. In its report the commission expressed the view that a maximum fare basis as prescribed "would be most likely to lessen the transportation burden of respondents and to harmonize with present day economic conditions with consequent fuller assurance to the respondents of realizing a fair return on their property investment." The commission also concluded that the Pullman surcharge is unreasonable and should be eliminated; that the present experimental fares in the Southern and Western districts are not unreasonable or otherwise unlawful; and that the present extra fares wherever maintained are not unreasonable. Opposition to the lower fare basis was expressed by the New York Central, the New York, New Haven & Hartford and the Pennsylvania, which contended that if placed in effect the fares would "reduce the revenues of the eastern carriers, with the most serious consequence to the three systems." On the other hand, the fare reductions are favored by such roads as the Baltimore & Ohio and the Norfolk & Western.

Equipment Orders Show Large Increases

Orders placed by the railroads during January and February for new equipment and materials, as reported in the Railway Age, indicate that such purchases have far exceeded the volume of orders placed during the comparable period of 1935. During the first two months of this year orders were reported for 60 locomotives, 8,286 freight cars, 37 passenger-train cars, 4 Diesel-powered streamlined trains and 298,300 tons of rail. These compare respectively with orders for one locomotive, 830 freight cars, no passenger-train cars, and 127,974 tons of rail reported in the same two months of 1935. Among the orders for motive power placed this year for domestic service are 50 steam locomotives, as compared with 28 for the entire year of 1935. The other 10 ordered this year are Diesels, thus bringing the total for all types to nearly three-fourths of the 83 of all types ordered during all of the previous year. The number of freight cars ordered during the first two months of the year is 44 per cent of the 18,699 freight cars ordered during the entire 12 months of 1935. The 298,300 tons of rail ordered during the two-month period this year amounts to 60 per cent of the 495,300 tons reported during 1935.

Asks Railroads and Labor to Negotiate

Pointing out that differences between the railroads and their employees arising out of efforts to effect economies in railway operation through the consolidation of facilities comprise a matter that is "capable of being settled to better advantage by negotiation than by legislation," President Roosevelt has asked the railroads and representatives of labor organizations to "confer with each other in a spirit of reasonableness and moderation." This message was contained in a letter which the President addressed to J. J. Pelley, president of the Association of American Railroads and J. A. Phillips, vice-chairman of the Railway Labor Executives Association.

"What disturbs me," said the President, "is the apparent inability of the managements and the men to cooperate in working out such common problems. Issues which ought to be settled by friendly negotiations are being fought out in the battle grounds of Congress and the courts." To the employees he said that "the principle of protecting employees against undue hardship from economy projects is only beginning to gain ground." "On the the other hand," he continued, "the managements ought to bear in mind that the principle of employee protection is steadily finding acceptance among responsible employers." Co-ordinator Eastman, the President said, had consented to defer proposed orders directing the unification of certain terminal facilities.

Association News

Maintenance of Way Club of Chicago

The last meeting for the season will be held at the Auditorium hotel, on Monday evening, April 27, when the officers for the new year will be elected. Instead of a speaker, the program will include some entertainment that is being arranged for by a committee of railway supplymen who are members of the club.

Bridge and Building Association

Forty members met at lunch in Chicago on Wednesday, March 11, during the convention of the A.R.E.A. Following the luncheon, members of the executive committee met at the Palmer House for a brief discussion of association activities. At this meeting, the action of the officers in selecting the Hotel Stevens, Chicago, as headquarters for the next convention, was ratified.

American Wood Preservers Association

The members of the executive committee met in Chicago on March 12 to complete the appointment of committees and to plan the work for the new year. To perfect closer co-ordination of activities with the Forest Products Laboratory, Madison, Wis., arrangements were made to hold the next meeting of the executive committee in that city in June. It is possible that this meeting may be made the occasion of an inspection of the laboratory and its work, in which members of the association at large may be invited to participate.

American Railway Engineering Association

President A. R. Wilson has announced that the thirty-eighth annual convention will be held at the Palmer House, Chicago, on March 16-18, 1937.

The booklet containing the Outline of Work and Personnel of the 25 regular and 6 special committees of the association is now in the hands of the printer and will soon be mailed to all committee members. Only four changes in committee chairmen have been made.

O. G. Wilbur, assistant engineer, valuation department, B. & O., Baltimore, Md., has been appointed chairman of the Committee on Buildings, to replace G. A. Rodman, general supervisor bridges and buildings, N.Y.,N.H. & H., New Haven, Conn.; G. I. Wright, chief electrical engineer, C. R.R. of N.J. and the Reading, Philadelphia, Pa., replaces J. V. B. Duer, chief electrical engineer, Penna., Philadelphia, Pa., as chairman of the Committee on Electricity; F. E. Morrow, chief engineer, C. & W.I., has been appointed to fill the vacancy in the chairmanship of the Committee on Waterways and Harbors, resulting from the death of A. P. Wenzell, late special engineer, N.Y.C., Chicago, and C. F. Ford, supervisor tie and timber department, Rock Island Lines, who has been acting as chairman of the Committee on Wood Preservation since the death of F. C. Shepherd, consulting engineer, B. & M., Boston, Mass., has been appointed chairman of that committee.

As in past years, most of the subjects assigned to committees are those upon which they have been at work for one or more years, although many of the committees have also received a number of new assignments. The list given below shows the more important new subjects assigned.

Roadway; the effect of physical properties of earth materials, particularly upon roadbed performance; culverts, factors determining their location and type; width of roadbed and angle of slopes; specifications for tunnel construction; and roadway signs required.

Ties—reuse of treated ties in track or elsewhere after their removal from their original position.

Rail—continuous welding of rail.

Buildings—air conditioning of buildings; improved wearing surfaces for platforms; design of railway buildings to withstand earthquake shocks; and stockpens.

Masonry—review of A.S.T.M. specifications for concrete culvert pipe; and rating of reinforced concrete bridges.

Highways—"Gates-Not-Working" and "Watchmen-Not-on-Duty" signs, and barrier type of grade crossing protection, including automatic gates.

Water Service, Fire Protection and Sanitation—means of reducing water waste; and classification of water service material.

Yards and Terminals—widths of driveways for freight houses and team yards.

Economics of Railway Labor—the effect of higher speeds on the labor cost of track maintenance.

Waterways and Harbors—sea and ocean protection; reasonable life of steel casings immersed in sea water; what is navigable water in fact; and waterway projects of the United States.

Maintenance of Way Work Equipment—development of work equipment, and scheduling the use of work equipment.

Special Committee on Live Load and Impact—tests of short steel spans with open floor, together with effect of inequalities of track and effect of rough wheels on such track; tests of steel spans with ballasted deck, including spans with precast concrete decks and poured-in-place concrete decks; also tests on ballasted decks with timber floor; particular attention to be given to the damping due to the type of deck and the track ballast; tests of dynamic shear in girder and truss spans; and tests of impact in columns and hangers of steel spans.

Bethlehem Track Spikes—The Bethlehem Steel Company, Bethlehem, Pa., has issued an illustrated folder, No. 346, which describes the characteristics and qualities of the wide range of standard and special size track spikes manufactured by the company. The folder also includes tabulated information on extra charges for special sizes and small lots.

Personal Mention

General

J. R. Watt, engineer maintenance of way of the Louisville & Nashville, has been appointed assistant purchasing agent, with headquarters as before at Louisville, Ky.

William K. Tate, formerly an assistant division engineer on the Nashville, Chattanooga & St. Louis, has been appointed assistant to the vice-president and traffic manager, with headquarters at Nashville, Tenn. Mr. Tate was born on January 13, 1898, at Tyler, Tex., and received his higher education at Vanderbilt university at Nashville. He entered the service of the N. C. & St. L. on March 13, 1917, as a draftsman in the engineering department, later serving as instrumentman and topographer on a survey party. On January 1,

William K. Tate

1918, he was appointed assistant division engineer on the Huntsville division, with headquarters at Tullahoma, Tenn., holding this position until October 1, 1918, when he volunteered for service in the United States Army, serving at the Officers Training Camp at Fort Monroe, Va. On December 1, 1918, Mr. Tate returned to his former position on the N. C. & St. L. at Tullahoma, where he remained until March 16, 1929, when he was appointed industrial engineer in the industrial and public relations division of the traffic department, with headquarters at Nashville holding this position until his recent appointment.

W. D. Supplee, whose promotion to superintendent on the Pennsylvania, with headquarters at Logansport, Ind., was noted in the February issue, was born on October 1, 1892, at Philadelphia, Pa. He received his higher education at Chestnut Hill Academy and was graduated from the University of Pennsylvania in 1913. He entered railway service with the Pennsylvania as a chainman on the Philadelphia Terminal division in October, 1915, and in April, 1916, was promoted to rodman with headquarters at Harrisburg, Pa., later being transferred to Altoona, Pa. In Au-

(Continued on page 254)

gust, 1917, he was furloughed for military service, but in 1919 he returned as assistant supervisor of track, with headquarters at Cresson, Pa., later serving in this capacity with headquarters at Jamesburg, N. J., and Paoli, Pa. In 1926 he was promoted to supervisor of track with headquarters at Dunkirk, N. Y., later serving in this capacity consecutively at Mansfield, Ohio, Washington, D. C., and New York City. In 1928 he was promoted to division engineer with headquarters at Logansport, serving in this capacity at Buffalo, N. Y., and at Philadelphia, Pa., where he was located until his recent promotion.

Engineering

L. L. Adams, division engineer on the Louisville & Nashville, at Evansville, Ind., has been promoted to engineer maintenance of way, at Louisville, Ky., succeeding **J. R. Watt,** whose appointment as assistant purchasing agent is noted elsewhere in these columns.

J. Davis, superintendent of the Arkansas division of the Missouri Pacific, with headquarters at Little Rock, Ark., has been appointed district engineer of the Southern district, with the same headquarters, to fill a position that has been vacant for some time.

V. R. Hayes, division engineer of the Wabash at Decatur, Ill., has been promoted to engineer of track, with headquarters at St. Louis, Mo., in which position he takes over the duties of the late **John J. Baxter,** assistant chief engineer, whose death was noted in the March issue. **Charles T. Warren,** division engineer of the Ann Arbor (a subsidiary of the Wabash), with headquarters at Owosso, Mich., has been transferred to Decatur to replace Mr. Hayes. **Byrl M. Bennett,** roadmaster of the Ann Arbor, with headquarters at Owosso, has been promoted to division engineer, replacing Mr. Warren. **D. Faries,** a draftsman in the chief engineer's office of the Wabash, has been appointed assistant engineer on the Montpelier division, to succeed **J. N. Sailor,** who has been transferred to Owosso on the Ann Arbor to succeed **Joel F. Holmberg,** whose appointment as roadmaster is noted elsewhere in these columns. These changes became effective on March 10.

Byrl M. Bennett

Mr. Bennett has been in railway service for 11 years. He was born on March 6, 1900, at Fort Wayne, Ind., and was educated at Tri-State College of Engineering, Angola, Ind., graduating in 1925. In March of the same year, Mr. Bennett entered the service of the Wabash as a rodman-transitman, serving in this position and as a bridge inspector until October, 1925, when he was appointed third assistant engineer, serving in this capacity at Montpelier, Ohio, Peru, Ind., and Moberly, Mo. On February 1, 1929, he was advanced to second assistant engineer at Moberly and six months later he was made first assistant engineer on the Ann Arbor at Owosso, Mich. On November 24, 1930, Mr. Bennett was advanced to roadmaster, which position he was holding, with headquarters at Owosso, at the time of his recent appointment as division engineer.

T. M. Pittman, Jr., assistant engineer on the Illinois Central, with headquarters at Water Valley, Miss., has been promoted to division engineer of the Mississippi division, with the same headquarters, succeeding **Samuel J. Holt,** whose death is noted elsewhere in these columns. **R. H. Carter,** supervisor on the Chicago Terminal division, has been appointed acting division engineer of the same division to replace **J. J. Desmond,** who has been granted a leave of absence because of ill health. **S. C. Jump,** supervisor with headquarters at Clinton, Ill., has been appointed acting division engineer of the Springfield division, with the same headquarters, to relieve **F. W. Armistead,** who has also been granted a leave of absence because of ill health.

Track

F. P. Funda, an assistant engineer on the Chicago, Rock Island & Pacific, has been promoted to roadmaster, with headquarters at Brinkley, Ark., succeeding **W. R. Coln,** deceased.

Joel F. Holmberg, assistant engineer on the Ann Arbor (a subsidiary of the Wabash), with headquarters at Owosso, Mich., has been promoted to roadmaster with the same headquarters, to succeed **Byrl M. Bennett,** who has been promoted to division engineer, as noted elsewhere in these columns.

Mr. Holmberg was born on December 18, 1905, at Council Bluffs, Iowa, and received his higher education at the University of Missouri, graduating in engineering in 1928. He entered railway service on August 1, 1929, as a rodman-transitman on the Wabash. On October 1 of the same year he was sent to the Ann Arbor as assistant engineer, in which position he continued until his recent appointment as roadmaster. On June 1 of this year, Mr. Holmberg's headquarters will be transferred to Cadillac, Mich.

George W. Varnum, assistant division engineer on the Atchison, Topeka & Santa Fe, whose appointment as roadmaster, with headquarters at Kingman, Ariz., was noted in the February issue, was born on November 17, 1889, at Montgomery City, Mo., and graduated from Iowa State College, Ames, Iowa, in 1919, with an engineering degree. In October, 1910, Mr. Varnum entered the service of the Santa Fe as a chairman in the engineering department at San Bernardino, Cal., but left the service in September, 1917, to enlist as a private in the United States Army, where he was subsequently commissioned a second lieutenant and assigned to duty at Camp Humphreys, Va., being commissioned a first lieutenant of engineers in September, 1918. On his discharge from the army, Mr. Varnum returned to the Santa Fe as a draftsman at Winslow, Ariz., and from June, 1922, until November, 1925, he was an assistant engineer on bridge design at Los Angeles, Cal., being on the latter date promoted to assistant engineer in the office of the district engineer at Los Angeles. On November 1, 1929, Mr. Varnum was appointed assistant division engineer at Needles, Cal., which position he was holding at the time of his recent appointment as roadmaster.

Bridge and Building

A. J. James, general foreman of bridges and buildings on the Atchison, Topeka & Santa Fe, with headquarters at Emporia, Kan., retired on February 29.

Benjamin W. Guppy, engineer of structures on the Boston & Maine, with headquarters at Portland, Me., has been transferred to Boston, Mass.

C. Black, bridge and building supervisor on the San Antonio division of the Southern Pacific Lines in Texas and Louisiana, with headquarters at San Antonio, Tex., retired on March 31, having reached the retirement age.

Obituary

W. R. Coln, roadmaster on the Chicago, Rock Island & Pacific, at Brinkley, Ark., died on March 6.

John Sutter Ruff, division engineer of the Providence division of the New York, New Haven & Hartford, with headquarters at Providence, R. I., died in that city on March 20, at the age of 52 years.

Thomas H. Kitzmiller, bridge and building foreman on the Baltimore & Ohio, with headquarters at Cumberland, Md., and formerly a master carpenter on this road, was drowned in the Potomac river at Pinto, Md., on March 9. The accident occured when Mr. Kitzmiller lost his footing and plunged forty feet into the river while working on the railroad's bridge at this point.

Samuel J. Holt, division engineer of the Mississippi division of the Illinois Central, with headquarters at Water Valley, Miss., died on March 7 at Fulton, Ky., of a heart attack. Mr. Holt was born on September 24, 1875, at Dulaney, Ky., and entered the service of the Illinois Central at the age of 17. After serving in various positions in the maintenance of way department, he was pro-

(Continued on page 256)

moted to supervisor at Central City, Ky., and thence to roadmaster of the Tennessee division, with headquarters at Fulton, Ky. Coincident with the consolidation of the Tennessee and Mississippi divisions in September, 1931, Mr. Holt was made division engineer of the Mississippi division.

Robert P. Graham, engineer maintenance of way of the Southern division of the Pennsylvania, died on March 17 at his home in Wilmington, Del. Mr. Graham was born at Altoona, Pa., on June 26, 1887, and was graduated from Pennsylvania State College in 1907. He entered the service of the Pennsylvania as a messenger in the telegraph office at Altoona on July 20, 1902, and served during subsequent summers as a clerk and rodman until he finished college. He re-entered the service in June, 1907, as a rodman on the Middle division at Altoona. On November 1, 1913, he was transferred to the office of the chief engineer of maintenance of way at Philadelphia, and on March 15, 1914, he was appointed assistant supervisor of the Conemaugh division at Freeport, Pa. He also served as assistant supervisor on the Baltimore division at York, Pa., and on the Philadelphia division at Paoli, Pa. On September 1, 1918, Mr. Graham was appointed a supervisor on the Cresson division at Barnesboro, Pa. He subsequently served as supervisor on the Philadelphia division at Lemoyne, Pa., on the Philadelphia Terminal division at West Philadelphia, Pa., and on October 1, 1927, he was promoted to division engineer of the Buffalo division at Buffalo, N. Y., later serving as division engineer of the Middle division at Altoona, Pa. He was promoted to superintendent of the Delaware division at Wilmington, Del., on May 16, 1928, being transferred to the St. Louis division at Terre Haute, Ind., on May 16, 1929. Mr. Graham became engineer of maintenance of way, Central Pennsylvania division, at Williamsport, Pa., on June 1, 1931. On July 1, 1933, he was transferred to the Southern division, with headquarters at Wilmington, Del.

Robert P. Graham

H. P. Burgess, who retired in 1925 as master carpenter of the Aurora division of the Chicago, Burlington & Quincy, with headquarters at Aurora, Ill., died on March 25. Mr. Burgess was born on August 27, 1854, at Warren, Me., and entered the service of the Burlington in 1876 as a bridgeman. On January 1, 1882, he was advanced to bridge foreman and 13 years later he was further promoted to superintendent of bridges of the Aurora division. In July, 1904, Mr. Burgess' title was changed to master carpenter of the same division, which position he retained until his retirement on July 1, 1925.

Frank L. Burckhalter, vice-president of the Southern Pacific, with headquarters at San Francisco, Cal., whose railway experience included many years in the engineering department of this company, died on March 3 of heart disease. Mr. Burckhalter was born at Truckee, Cal., in 1879, and was graduated from the University of California in 1900. Shortly thereafter he entered railway service as a rodman in the engineering department of the Southern Pacific and later served until February, 1902, as a levelman and computor on location survey parties, then being promoted successively to assistant engineer, contruction foreman and roadmaster. From March, 1906, to November, 1911, he served as division engineer at Bakersfield, Cal., and at Los Angeles, then being promoted to district engineer at Portland, Ore. On March 1, 1914, Mr. Burckhalter was transferred to the operating department as superintendent of the Portland division, with headquarters at Portland, Ore. He was promoted to assistant general manager, with headquarters at San Francisco, on September 1, 1918, being further promoted to first assistant general manager with the same headquarters, on June 1, 1925. On January 1, 1929, Mr. Burckhalter was advanced to general manager of the Pacific Lines of the Southern Pacific, which position he held until his election as vice-president in March, 1933.

Frank L. Burckhalter

Supply Trade News

Personal

Harold T. Henry, eastern district sales manager of the **Q & C Company,** New York, has resigned effective April 1, to become manager of the railroad sales of the **Burden Iron Company,** Troy, N.Y.

J. R. C. Hintz, until recently railway sales division manager of the Detroit Graphite Company, has been appointed eastern sales representative of the **Acme White Lead & Color Works,** Detroit, Mich. Mr. Hintz's headquarters are at New York.

Franklin C. Vandervort, Jr., has again become associated with the **Johns-Manville Sales Corporation,** with headquarters at Chicago. Mr. Vandervort was formerly associated with the Transportation department, and is now re-entering the Johns-Manville service as representative in the western region of its sales organization.

E. C. Argust, assistant to the president of the **Morden Frog & Crossing Works,** Chicago, has been elected vice-president and secretary, to succeed **J. F. Karcher,** deceased. After graduating from the St. Louis Manual Training school, Mr. Argust entered the employ of the Elliott Frog & Switch Company, East St. Louis, Ill., as a draftsman on April 1, 1903. On September 6, 1906, he resigned to assist in the organization of the St. Louis Frog & Switch Company, St. Louis, Mo., and after serving in various capacities was advanced to secretary. After the liquidation of this company in 1932, he entered the employ of the Morden Frog & Crossing Works as assistant to the president.

E. C. Argust

One Man—One Rail—The American Trackbarrow Company, Lowell, Mass., has issued a 12-page pocket-size folder with this title, which illustrates and points out the important features and dimensions of its complete line of one-rail trackbarrows, carbarrows and pony cars, together with the principal adaptations of these units of equipment for various services.

Duplex Compressors—The Ingersoll-Rand Company, New York, has issued a 35-page attractively-printed brochure in which is listed and described this company's line of power-driven, horizontal duplex, double-acting, cross-head type, heavy-duty compressors.

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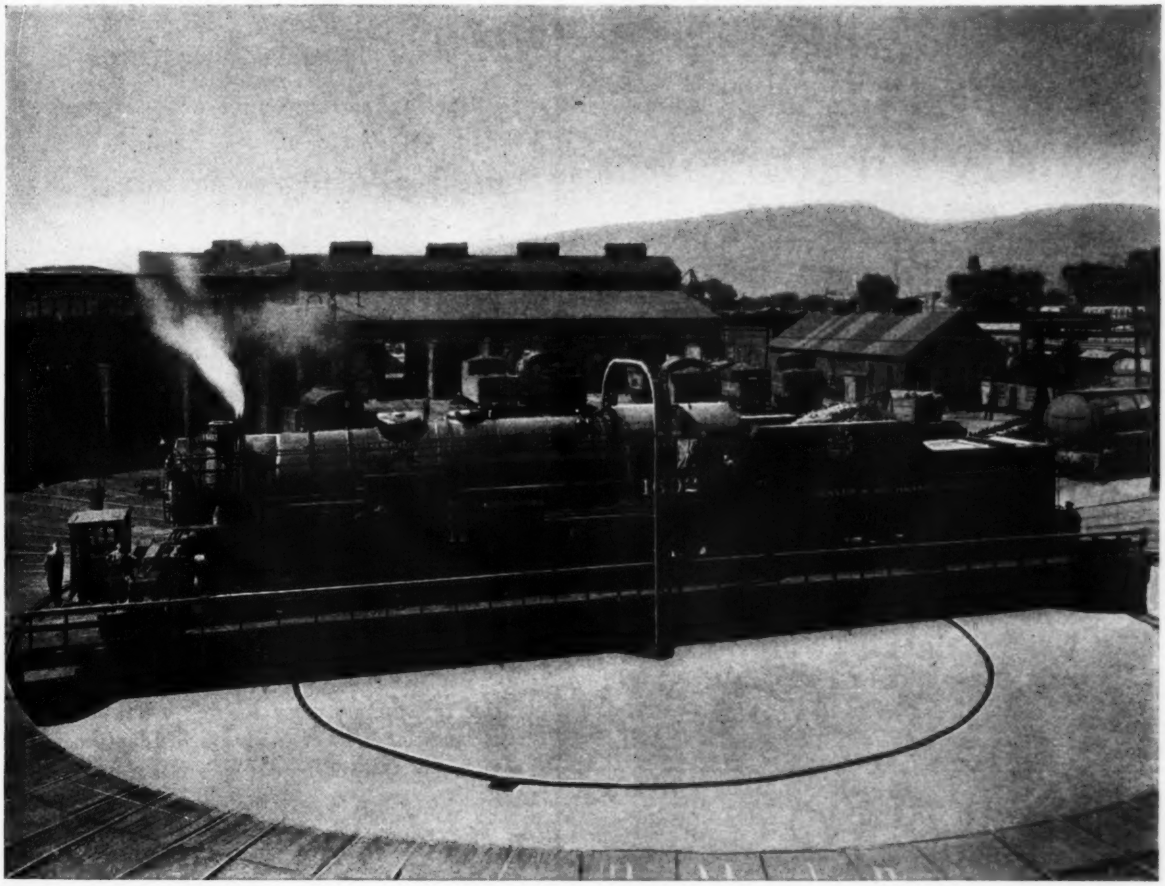

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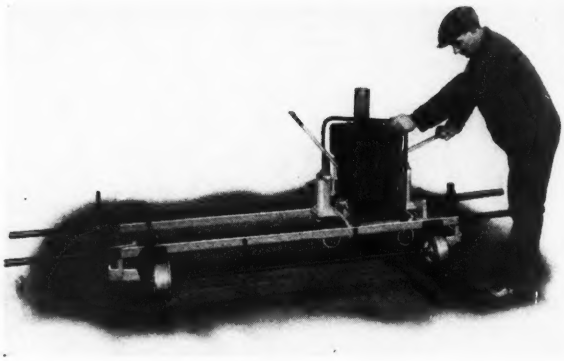

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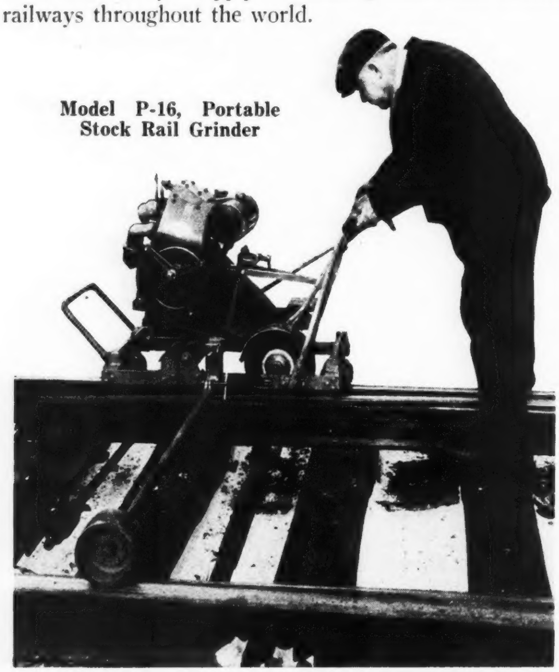

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